

PATENT ABSTRACTS OF JAPAN

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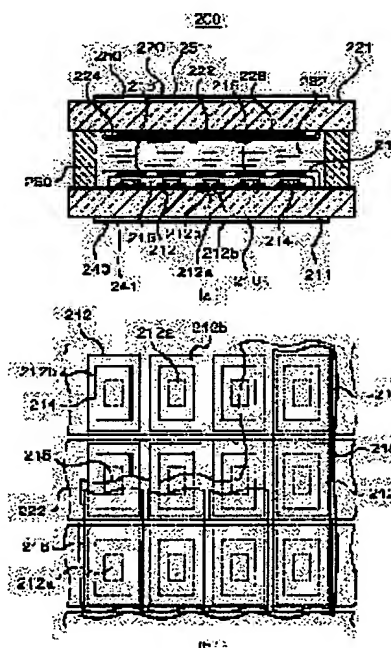
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(54) ELECTRO-OPTICAL DEVICE, COLOR FILTER SUBSTRATE AND ELECTRONIC APPARATUS

(57)Abstract:

PROBLEM TO BE SOLVED: To provide an electro-optical device and a color filter substrate capable of ensuring both brightness of reflective display and saturation of transmissive display when used in a display device capable of performing both reflective display and transmissive display.

SOLUTION: A reflective layer 212 having an aperture 212a for each pixel is formed on a first substrate 211, and a colored layer 214 for constituting a color filter is formed thereon. A surface protection layer 215 is formed on the colored layer 214, and a transparent 216 is formed further thereon. The colored layer 214 is constituted so as to cover the aperture 212a in a two-dimensional direction, but overlaps only a part of a reflection surface in the pixel in a two-dimensional direction.



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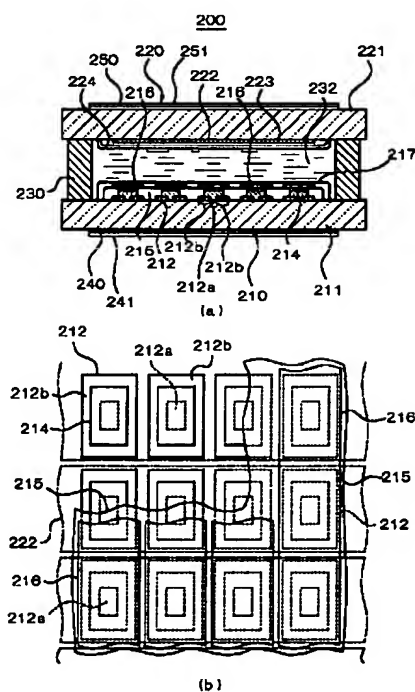
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【特許請求の範囲】

【請求項1】 電気光学装置において、

一对の基板間に配置された電気光学物質層と、
前記一对の基板のうち一方の基板と前記電気光学物質層との間に配置された着色層と、
前記電気光学物質層および前記着色層を通過した光を反射する反射部と開口部とを有する反射層とを備え、
前記着色層は前記開口部に配置されているとともに、
前記反射部上の一部にのみ配置されていることを特徴とする電気光学装置。

【請求項2】 前記反射部の面積に対する前記着色層が配置されている前記反射部の面積の比は、前記開口部の面積に対する前記着色層が配置されている前記開口部の面積の比よりも小さいことを特徴とする請求項1に記載の電気光学装置。

【請求項3】 前記着色層は前記開口部を完全に覆うように配置されていることを特徴とする請求項1又は請求項2に記載の電気光学装置。

【請求項4】 前記着色層は前記開口部上から前記開口部周囲の前記反射部上に張り出すように配置されていることを特徴とする請求項1又は請求項2に記載の電気光学装置。

【請求項5】 電気光学装置において、

一对の表示用電極と、
前記一对の表示用電極の間に配置された電気光学物質層と、
前記一对の表示用電極の平面的な重なり領域に対応して配設された複数の画素と、
各々の前記画素内に配置された着色層と、
各々の前記画素内に配置され、前記電気光学物質層および前記着色層を通過した光を反射する反射部と開口部とを有する反射層とを備え、
前記着色層は前記開口部に配置されているとともに、
前記反射部上の一部に配置されていることを特徴とする電気光学装置。

【請求項6】 前記複数の画素のそれぞれに対応する前記開口部の面積は、互いに実質的に同一であり、前記複数の画素の少なくとも一つに対応する前記着色層の面積は、その他の前記複数の画素に対応する前記着色層の面積とは異なることを特徴とする請求項5に記載の電気光学装置。

【請求項7】 電気光学装置において、

複数の画素上に配置された電気光学物質層と、
前記画素上に配置された、相互に異なる色を有する複数種類の着色層と、
各々の前記画素上に配置され、前記電気光学物質層および前記着色層を通過した光を反射する反射部と開口部とを有する反射層とを備え、
前記着色層は前記開口部及び前記反射部上に配置されているとともに、前記複数種類の着色層のうちの少なくとも

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も一種の前記着色層が前記反射部上の一部にのみ配置されていることを特徴とする電気光学装置。

【請求項8】 前記反射部の開口部の面積は、異なる色の前記着色層を備えた前記画素間で同一に構成されていることを特徴とする請求項7に記載の電気光学装置。

【請求項9】 前記着色層の前記反射部上の被覆面積率は、少なくとも2つの異なる色の前記着色層を備えた前記画素間で異なることを特徴とする請求項7に記載の電気光学装置。

10 【請求項10】 赤、緑、青の各色の前記着色層を備え、緑の前記着色層の前記被覆面積率は赤及び青の前記着色層の前記被覆面積率よりも小さいことを特徴とする請求項9に記載の電気光学装置。

【請求項11】 緑の前記着色層の前記被覆面積率は30～50%であり、赤及び青の前記着色層の前記被覆面積率は60～100%であることを特徴とする請求項10に記載の電気光学装置。

20 【請求項12】 前記反射部は前記開口部の全周囲に配置されていることを特徴とする請求項1、5又は7に記載の電気光学装置。

【請求項13】 前記開口部による前記反射層に対する開口率は、30～70%であることを特徴とする請求項1、5又は7に記載の電気光学装置。

【請求項14】 請求項1、5又は7に記載の電気光学装置と、該電気光学装置を制御する制御手段とを有することを特徴とする電子機器。

【請求項15】 カラーフィルタ基板において、
基板と、
前記基板上に配置され、光を反射する反射部と開口部とを有する反射層と、
前記基板上に配置された着色層とを備え、
前記着色層は前記開口部に配置されるとともに、前記反射部上の一部にのみ配置されていることを特徴とするカラーフィルタ基板。

【請求項16】 カラーフィルタ基板において、
画素が設定された基板と、
前記画素に合わせて前記基板上に配置された着色層と、
前記画素に合わせて前記基板上に配置され、光を反射する反射部と開口部とを有する反射層とを備え、
40 前記着色層は前記開口部に配置されるとともに、前記反射部上の少なくとも一部に配置されていることを特徴とするカラーフィルタ基板。

【請求項17】 カラーフィルタ基板において、
画素が設定された基板と、
前記画素に合わせて前記基板上に配置された、相互に異なる色を有する複数種類の着色層と、
前記画素に合わせて前記基板上に配置され、光を反射する反射部と開口部とを有する反射層とを備え、
前記着色層は前記開口部及び前記反射部上に配置され
50 とともに、前記複数種類の着色層のうちの少なくとも一

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種の前記着色層が前記反射部上の一部にのみ配置されていることを特徴とするカラーフィルタ基板。

【発明の詳細な説明】

【0001】

【発明の属する技術分野】本発明は電気光学装置、カラーフィルタ基板及び電子機器に係り、特に、反射層を有するカラー電気光学装置の構造として好適な技術に関する。

【0002】

【従来の技術】従来から、外光を利用した反射型表示と、バックライト等の照明光を利用した透過型表示とのいずれをも視認可能とした反射半透過型の液晶表示パネルが知られている。この反射半透過型の液晶表示パネルは、そのパネル内に外光を反射するための反射層を有し、この反射層をバックライト等の照明光が透過できるように構成したものである。この種の反射層としては、液晶表示パネルの画素毎に所定面積の開口部（スリット）を備えたものがある。

【0003】図20は、従来の反射半透過型の液晶表示パネル100の概略構造を模式的に示す概略断面図である。この液晶表示パネル100は、基板101と基板102とがシール材103によって貼り合せられ、基板101と基板102との間に液晶104を封入した構造を備えている。

【0004】基板101の内面上には、画素毎に開口部111aと反射部111bとを有する反射層111が形成され、この反射層111の上に着色層112r、112g、112b及び表面保護層112pを備えたカラーフィルタ112が形成されている。カラーフィルタ112の表面保護層112pの表面上には透明電極113が形成されている。

【0005】一方、基板102の内面上には透明電極121が形成され、対向する基板101上の上記透明電極113と交差するように構成されている。なお、基板101上や基板102上には、配向膜や硬質透明膜などが必要に応じて適宜に形成される。

【0006】また、上記の基板102の外面上には位相差板（1/4波長板）105及び偏光板106が順次配置され、基板101の外面上には位相差板（1/4波長板）107及び偏光板108が順次配置される。

【0007】以上のように構成された液晶表示パネル100は、携帯電話、携帯型情報端末などの電子機器に設置される場合、その背後にバックライト109が配置された状態で取付けられる。この液晶表示パネル100においては、昼間や屋内などの明るい場所では反射経路Rに沿って外光が液晶104を透過した後反射部111bにて反射され、再び液晶104を透過して放出されるので、反射型表示が視認される。一方、夜間や野外などの暗い場所ではバックライト109を点灯させることにより、バックライト109の照明光のうち開口部111

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aを通過した光が透過経路Tに沿って液晶表示パネル100を通過して放出されるので、透過型表示が視認される。

【0008】

【発明が解決しようとする課題】しかしながら、上記従来の反射半透過型の液晶表示パネル100においては、上記反射経路Rでは光がカラーフィルタ112を2回通過するのに対し、上記透過経路Tでは光がカラーフィルタ112を一度だけ通過するため、透過型表示の明度に較べて反射型表示の明度が低下し、また、反射型表示の彩度に対して透過型表示における彩度が悪くなるという問題点がある。すなわち、反射型表示では一般的に表示の明るさが不足しがちであるので、カラーフィルタ112の光透過率を高く設定して表示の明るさを確保する必要があるが、このようにすると、透過型表示において十分な彩度を得ることができなくなる。

【0009】また、上記のように反射型表示と透過型表示とにおいては光がカラーフィルタを通過する回数が異なるので、反射型表示の色彩と、透過型表示の色彩とが大きく異なってしまうため、違和感を与えるという問題点もある。

【0010】そこで本発明は上記問題点を解決するものであり、その課題は、反射型表示と透過型表示の双方を可能にする表示装置に用いた場合に、反射型表示の明るさと透過型表示の彩度とを共に確保することの可能なカラーフィルタ基板を提供することにある。また、反射型表示の明るさと透過型表示の彩度とを共に確保することの可能な反射半透過型の電気光学装置を提供することにある。さらに、反射型表示と透過型表示との間の色彩の差異を低減することのできる表示技術を実現することを目的とする。

【0011】

【課題を解決するための手段】上記課題を解決するために本発明者は、反射層の一部にのみ着色層が平面的に重なるように構成し、反射層のその他の部分には着色層が重ならないように構成することにより、当該反射層によって反射される反射光の明るさを確保することができることを見出した。

【0012】特に、反射半透過型の電気光学装置の場合には、光学的開口を備えた反射層を設けた上で、光学的開口には着色層が少なくとも部分的に重なるように構成する一方、反射層の一部にのみ着色層が重なるように構成することにより、反射型表示の明るさを確保しつつ透過型表示の彩度を向上させることができる。

【0013】より具体的には、着色層を光学的開口に重ねた状態で透過型表示が良好に得られるように、予め着色層を所定の色濃度に設定しておき、その後、着色層が反射層と重なる割合を調節することによって反射型表示の明るさを確保することができる。

【0014】本発明の電気光学装置は、一対の基板間に

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配置された電気光学物質層（例えば液晶層）と、前記一対の基板のうち一方の基板と前記電気光学物質層との間に配置された着色層と、前記電気光学物質層および前記着色層を通過した光を反射する反射部と開口部とを有する反射層とを備え、前記着色層は前記開口部に配置されているとともに、前記反射部上の一部にのみ配置されていることを特徴とする。

【0015】この発明によれば、着色層が開口部に配置されているとともに反射部上の一部にのみ配置されていることにより、着色層の反射層に対する重なり割合に応じて反射光の明るさを調整することが可能になる一方、このような調整は着色層と光学的開口との重なり状態には無関係であるので、透過光の色彩には影響を与えないようにすることができる。したがって、反射光に対する着色層の影響と透過光に対する着色層の影響を相互に独立して設定することが可能になる。

【0016】ここで、前記反射層の面積に対する前記着色層と重なる前記反射部の部分の面積の比（以下、単に「反射着色比」という。）は、前記開口部の面積に対する前記着色層と重なる前記開口部の部分の面積の比（以下、単に「透過着色比」という。）よりも小さいことが好ましい。反射光は着色層を2回透過するのに対して光学的開口を通過する透過光は着色層を1回だけ透過するので、通常であれば反射光の明度は透過光より低くなり、透過光の彩度は反射光の彩度より低くなるが、反射着色比を透過着色比よりも小さくすることにより、反射光の明るさを高めることができるとともに透過光の彩度を相対的に向上させることができ、反射光と透過光との間の色彩の相違を低減することができる。

【0017】また、前記着色層が前記開口部を完全に覆うように配置されていることが好ましい。着色層が光学的開口を完全に覆うように配置されていることにより、透過光の彩度をさらに高めることができる。

【0018】ここで、前記反射層及び前記着色層は前記一対の基板のうち一方の前記基板上に配置されている場合があり、また、前記反射層は前記一対の基板のうち一方の前記基板上に配置され、前記着色層は前記一対の基板のうち他方の基板上に配置されている場合もある。いずれの場合であっても、光学的に同様の作用効果を得ることができる。

【0019】また、前記着色層は前記開口部上から前記開口部周囲の前記反射部上に張り出すように配置されていることが好ましい。開口部上からその周囲の反射部上に張り出すように着色層が配置されていることにより、着色層を一体のものとして形成することが可能になる。したがって、着色層のパターンをそれほど細かく形成する必要がなくなり、より容易にしかも高い歩留まりで製造することができる。

【0020】また、本発明の別の電気光学装置は、複数の画素上に配置された電気光学物質層と、各々の前記画

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素上に配置された着色層と、各々の前記画素上に配置され、前記電気光学物質層および前記着色層を通過した光を反射する反射部と開口部とを有する反射層とを備え、前記着色層は前記開口部に配置されているとともに、前記反射部上の一部にのみ配置されていることを特徴とする。

【0021】本発明によれば、複数の画素において、着色層が開口部に配置されているとともに反射部上の一部にのみ配置されていることにより、着色層の反射層に対する重なり割合に応じて反射光の明るさを画素毎に調整することが可能になる一方、このような調整は着色層と光学的開口との重なり状態には無関係であるので、透過光の色彩には影響を与えないようにすることができる。したがって、反射光に対する着色層の影響と透過光に対する着色層の影響を画素毎に相互に独立して設定することが可能になる。

【0022】ここで、各々の前記画素において、前記反射部の全面積に対する前記着色層と重なる前記反射部の部分の面積の比は、前記開口部の全面積に対する前記着色層と重なる前記開口部の部分の面積の比よりも小さいことが好ましい。反射光は着色層を2回透過するのに対して光学的開口を通過する透過光は着色層を1回だけ透過するので、通常であれば反射光の明度は透過光より低くなり、透過光の彩度は反射光の彩度より低くなるが、反射着色比を透過着色比よりも小さくすることにより、画素毎に反射光の明るさを高めることができるとともに透過光の彩度を相対的に向上させることができ、反射光と透過光との間の色彩の相違を画素毎に低減することができる。

【0023】また、前記着色層が前記開口部を完全に覆うように配置されていることが好ましい。着色層が光学的開口を完全に覆うように配置されていることにより、透過光の彩度をさらに高めることができる。

【0024】さらに、前記電気光学物質層を挟持した一対の基板を備え、前記反射層及び前記着色層は前記一対の基板のうち一方の基板上に配置されている場合があり、また、前記反射層は前記一対の基板のうち一方の前記基板上に配置され、前記着色層は前記一対の基板のうち他方の前記基板上に配置されている場合もある。いずれの場合であっても、光学的に同様の作用効果を得ることができる。

【0025】また、各々の前記画素において、前記着色層は前記開口部上から前記開口部周囲の前記反射部上に張り出すように配置されていることが好ましい。これによれば、画素毎に、開口部に平面的に重なる領域から周囲の前記反射層上に張り出した一体構造となるように着色層を設けることができるので、着色層のパターンをそれほど細かく形成する必要がなくなり、より容易に、しかも高い歩留まりで製造することができる。

【0026】また、本発明の異なる電気光学装置は、一

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対の表示用電極と、前記一对の表示用電極の間に配置された電気光学物質層と、前記一对の表示用電極の平面的な重なり領域に対応して配設された複数の画素と、各々の前記画素内に配置された着色層と、各々の前記画素内に配置され、前記電気光学物質層および前記着色層を通過した光を反射する反射部と開口部とを有する反射層とを備え、前記着色層は前記開口部上に配置されているとともに、前記反射部上の一部に配置されていることを特徴とする。

【0027】この場合に、前記複数の画素のそれぞれに対応する前記開口部の面積は、互いに実質的に同一であり、前記複数の画素の少なくとも一つに対応する前記着色層の面積は、その他の前記複数の画素に対応する前記着色層の面積とは異なることが好ましい。

【0028】さらに、本発明の別の電気光学装置は、複数の画素上に配置された電気光学物質層と、前記画素上に配置された、相互に異なる色を有する複数種類の着色層と、各々の前記画素上に配置され、前記電気光学物質層および前記着色層を通過した光を反射する反射部と開口部とを有する反射層とを備え、前記着色層は前記開口部及び前記反射部上に配置されているとともに、前記複数種類の着色層のうちの少なくとも一種の前記着色層が前記反射部上の一部にのみ配置されていることを特徴とする。

【0029】本発明において、前記反射層の開口部の面積は、異なる色の前記着色層を備えた前記画素間で同一に構成されていることが好ましい。反射層の開口部の面積が異なる色の着色層を備えた画素間で同一に構成されていることにより、各色の画素において入射光量を等しくすることができるため、透過表示の色調整を比較的簡単に行うことが可能になる。また、反射部の面積についても異なる色の着色層を備えた画素間で同一に構成されるので、反射表示の色調整を行う際に、各色に対する着色層の反射部上の面積を調整しやすくなる。

【0030】本発明において、前記着色層の前記反射部上の被覆面積率（上記の反射着色比と同等）は、少なくとも2つの異なる色の前記着色層を備えた前記画素間で異なることが好ましい。これにより、開口部の透過光によって実現される透過表示の色を最適化するように各色の着色層の光学特性を調整するとともに、反射部と重なる各色の着色層の被覆面積率を調整することにより反射表示の色を最適化するということが可能になる。したがって、各色についてそれぞれ透過表示の色と反射表示の色とを独立に調整することができる。

【0031】本発明において、赤、緑、青の各色の前記着色層を備え、緑の前記着色層の前記被覆面積率は赤及び青の前記着色層の前記被覆面積率よりも小さいことが好ましい。透過表示は、開口部と重なる領域において着色層を1回だけ透過した光により構成されるが、反射表示は、反射部と重なる領域において着色層を2回透過す

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る光により主として構成され、部分的に開口部と重なる領域における着色層による反射光にも影響される。したがって、一般的に反射表示は透過表示よりも彩度が高くなる反面、暗くなりやすい。ところで、比視感度は黄緑の波長領域にピークを有するため、赤及び青の光の彩度が上がると暗くなるのに対して、緑の光の彩度を上げて暗くならにくい。これにより、反射表示において明度を高めようとするれば、特に赤や青の彩度が低下しやすくなる。したがって、赤や青の画素においては、被覆面積率を高くして（すなわち、着色層と重ならない反射部の面積をなくすか、或いは、少なくして）彩度を確保し、緑の画素においては被覆面積率を低くする（すなわち、着色層と重ならない反射部の面積を増大させる）ことにより反射光量をかせぐようにすれば、反射表示の色再現性を確保しつつ、明度を大幅に増大させることが可能になる。

【0032】本発明において、緑の前記着色層の前記被覆面積率は30～50%であり、赤及び青の前記着色層の前記被覆面積率は60～100%であることが好ましい。緑の被覆面積率と赤及び青の被覆面積率を上記範囲に設定することにより、透過表示の色再現性を確保しつつ、反射表示の色再現性及び明度を向上させることができる。特に、緑の着色層の被覆面積率としては35～45%、赤及び青の着色層の被覆面積率としては85～100%の範囲であることが最も望ましい。

【0033】本発明において、前記反射部は前記開口部の全周囲に配置されていることが好ましい。これにより、反射層において開口部が反射部により取り囲まれた状態に形成されていることとなるため、着色層と反射層との間に多少の位置ずれが発生したとしても、着色層で覆われない領域が開口部に生じないようにすることができる。特に、前記開口部は前記反射層の略中央に形成されていることが望ましい。

【0034】本発明において、前記開口部による前記反射層に対する開口率は、30～70%であることが好ましい。一般に、反射層の開口率が大きくなると透過表示は明るくなるが、反射表示は逆に暗くなるので、透過表示と反射表示のバランスを採るように反射層の開口率を設定する必要がある。より具体的には、開口率が小さすぎると、バックライトの照度を高くする必要があり、バックライトの消費電力が増大する。また、開口率が大きすぎると、反射表示が暗くなり視認しにくくなる。本実施形態では、反射部の一部に着色層と重ならない領域が設けられることにより反射表示の明るさをかせぐことができるので、反射層全体に着色層を重ねた構造を採用する場合に較べて、開口率が大きい上記範囲で透過表示と反射表示のバランスをとることが可能になり、透過表示と反射表示の双方において良好なカラー品位を実現することができる。開口率が上記範囲を下回ると、透過表示の明度を確保する必要から消費電力が増大するので携帯

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電話等の携帯型電子機器には採用しにくくなる。また、開口率が上記範囲を上回ると、反射表示における明度と彩度の両立が困難になり、反射表示におけるカラー品位を確保することが難しくなる。

【0035】本発明の電子機器は、上記いずれかの電気光学装置と、この電気光学装置を制御する制御手段とを有することを特徴とする。特に、電気光学装置としてのカラー表示可能な液晶表示装置を備えた電子機器、例えば、携帯電話、携帯型情報端末、液晶表示機能を有する撮像装置など、が挙げられる。これによって、電子機器の表示部として電気光学装置を用いる場合には、反射型表示と透過型表示との色彩の相違を低減し、高い表示品位を実現することができる。

【0036】なお、反射型表示と透過型表示にはそれぞれに適した色彩の発色態様があり、それぞれに別個のカラーフィルタを設けることができるのであればよいが、実際には、共通のカラーフィルタで双方の表示を実現しなければならない。本発明においては、上記のように反射着色比と透過着色比とを相互に変えることによって、着色層が共通であっても反射型表示の着色態様と透過型表示の着色態様とを別々に設定することが可能になる。

【0037】次に、本発明のカラーフィルタ基板は、基板と、前記基板上に配置され、光を反射する反射部と開口部とを有する反射層と、前記基板上に配置された着色層とを備え、前記着色層は前記開口部に配置されるとともに、前記反射部上の一部にのみ配置されていることを特徴とする。

【0038】本発明によれば、着色層が開口部に配置されているとともに反射部上の一部にのみ配置されていることにより、着色層の反射層に対する重なり割合に応じて反射光の明るさを調整することが可能になる一方、このような調整は着色層と光学的開口との重なり状態には無関係であるので、透過光の色彩には影響を与えないようにすることができる。したがって、反射光に対する着色層の影響と透過光に対する着色層の影響を相互に独立して設定することが可能になる。

【0039】ここで、前記反射部の全面積に対する前記着色層が配置されている前記反射部の面積の比は、前記開口部の全面積に対する前記着色層が配置されている前記開口部の面積の比よりも小さいことが好ましい。反射光は着色層を2回透過するのに対して光学的開口を通過する透過光は着色層を1回だけ透過するので、通常であれば反射光の明度は透過光より低くなり、透過光の彩度は反射光の彩度より低くなるが、反射着色比を透過着色比よりも小さくすることにより、画素毎に反射光の明るさを高めることができるとともに透過光の彩度を相対的に向上させることができ、反射光と透過光との間の色彩の相違を画素毎に低減することができる。

【0040】また、前記着色層が前記開口部を完全に覆うように配置されていることが好ましい。着色層が光

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学的開口を完全に覆うように配置されていることにより、透過光の彩度をさらに高めることができる。

【0041】さらに、前記着色層は前記開口部上から前記開口部周囲の前記反射部に張り出すように配置されていることが好ましい。開口部上からその周囲の反射部に張り出すように着色層が配置されていることにより、着色層を一体のものとして形成することが可能になる。したがって、着色層のパターンをそれほど細かく形成する必要がなくなり、より容易にしかも高い歩留まりで製造することができる。

【0042】また、本発明の別のカラーフィルタ基板は、画素が設定された基板と、前記画素に合わせて前記基板上に配置された着色層と、前記画素に合わせて基板上に配置され、光を反射する反射部と開口部とを有する反射層とを備え、前記着色層は前記開口部に配置されるとともに、前記反射部上の少なくとも一部に配置されていることを特徴とする。

【0043】この発明によれば、着色層が開口部に配置されているとともに反射部上の一部にのみ配置されていることにより、着色層の反射層に対する重なり割合に応じて反射光の明るさを画素毎に調整することが可能になる一方、このような調整は着色層と光学的開口との重なり状態には無関係であるので、透過光の色彩には影響を与えないようにすることができる。したがって、反射光に対する着色層の影響と透過光に対する着色層の影響を相互に独立して設定することが可能になる。

【0044】ここで、前記反射部の全面積に対する前記着色層が配置された前記反射部の面積の比は、前記開口部の全面積に対する前記着色層が配置された前記開口部の面積の比よりも小さいことが好ましい。反射光は着色層を2回透過するのに対して光学的開口を通過する透過光は着色層を1回だけ透過するので、通常であれば反射光の明度は透過光より低くなり、透過光の彩度は反射光の彩度より低くなるが、反射着色比を透過着色比よりも小さくすることにより、画素毎に反射光の明るさを高めることができるとともに透過光の彩度を相対的に向上させることができ、反射光と透過光との間の色彩の相違を画素毎に低減することができる。

【0045】また、前記着色層が前記開口部を完全に覆うように配置されていることが好ましい。着色層が光学的開口を完全に覆うように配置されていることにより、透過光の彩度をさらに高めることができる。

【0046】さらに、前記着色層は前記開口部上から前記開口部周囲の前記反射部に張り出すように配置されていることが好ましい。開口部上からその周囲の反射部に張り出すように着色層が配置されていることにより、着色層を一体のものとして形成することが可能になる。したがって、着色層のパターンをそれほど細かく形成する必要がなくなり、より容易にしかも高い歩留まりで製造することができる。

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【0047】次に、本発明の別のカラーフィルタ基板は、画素が設定された基板と、前記画素に合わせて前記基板上に配置された、相互に異なる色を有する複数種類の着色層と、前記画素に合わせて前記基板上に配置され、光を反射する反射部と開口部とを有する反射層とを備え、前記着色層は前記開口部及び前記反射部に配置されるとともに、前記複数種類の着色層のうちの少なくとも一種の前記着色層が前記反射部上の一部にのみ配置されていることを特徴とする。

【0048】本発明において、前記反射層の開口部の面積は、異なる色の前記着色層を備えた前記画素間で同一に構成されていることが好ましい。反射層の開口部の面積が異なる色の着色層を備えた画素間で同一に構成されていることにより、各色の画素において入射光量を等しくすることができるため、透過表示の色調整を比較的簡単に行うことが可能になる。また、反射部の面積についても異なる色の着色層を備えた画素間で同一に構成されるので、反射表示の色調整を行う際に、各色に対する着色層の反射部上の面積を調整しやすくなる。

【0049】また、前記着色層の前記反射部上の被覆面積率は、少なくとも2つの異なる色の前記着色層を備えた前記画素間で異なることが好ましい。これにより、開口部の透過光によって実現される透過表示の色を最適化するように各色の着色層の光学特性を調整するとともに、反射部と重なる各色の着色層の被覆面積率を調整することにより反射表示の色を最適化するということが可能になる。したがって、各色についてそれぞれ透過表示の色と反射表示の色とを独立に調整することができる。

【0050】この場合に、赤、緑、青の各色の前記着色層を備え、緑の前記着色層の前記被覆面積率は赤及び青の前記着色層の前記被覆面積率よりも小さいことが望ましい。透過表示は、開口部と重なる領域において着色層を1回だけ透過した光により構成されるが、反射表示は、反射部と重なる領域において着色層を2回透過する光により主として構成され、部分的に開口部と重なる領域における着色層による反射光にも影響される。したがって、一般的に反射表示は透過表示よりも彩度が高くなる反面、暗くなりやすい。ところで、比視感度は黄緑の波長領域にピークを有するため、赤及び青の光の彩度が上がると暗くなるのに対して、緑の光の彩度を上げて暗くするのにくい。これにより、反射表示において明度を高めようとするれば、特に赤や青の彩度が低下しやすくなる。したがって、赤や青の画素においては、被覆面積率を高くして（すなわち、着色層と重ならない反射部の面積をなくすか、或いは、少なくして）彩度を確保し、緑の画素においては被覆面積率を低くする（すなわち、着色層と重ならない反射部の面積を増大させる）ことにより反射光量をかせぐようにすれば、反射表示の色再現性を確保しつつ、明度を大幅に増大させることが可能にな

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【0051】さらに、緑の前記着色層の前記被覆面積率は30～50%であり、赤及び青の前記着色層の前記被覆面積率は60～100%であることが好ましい。緑の被覆面積率と赤及び青の被覆面積率を上記範囲に設定することにより、透過表示の色再現性を確保しつつ、反射表示の色再現性及び明度を向上させることができる。特に、緑の着色層の被覆面積率としては35～45%、赤及び青の着色層の被覆面積率としては85～100%の範囲であることが最も望ましい。

【0052】また、前記反射部は前記開口部の全周囲に配置されていることが好ましい。これにより、反射層において開口部が反射部により取り囲まれた状態に形成されていることとなるため、着色層と反射層との間に多少の位置ずれが発生したとしても、着色層で覆われない領域が開口部に生じないようにすることができる。特に、前記開口部は前記反射層の略中央に形成されていることが望ましい。

【0053】さらに、前記開口部による前記反射層に対する開口率は、30～70%であることが好ましい。一般に、反射層の開口率が大きくなると透過表示は明るくなるが、反射表示は逆に暗くなるので、透過表示と反射表示のバランスを採るように反射層の開口率を設定する必要がある。より具体的には、開口率が小さすぎると、バックライトの照度を高くする必要があり、バックライトの消費電力が増大する。また、開口率が大きすぎると、反射表示が暗くなり視認しにくくなる。本実施形態では、反射部の一部に着色層と重ならない領域が設けられることにより反射表示の明るさをかせぐことができるので、反射層全体に着色層を重ねた構造を採用する場合や、反射部に重なる部分と開口部に重なる部分とで異なる光学特性の着色層を構成する場合などに較べて、開口率が大きい上記範囲で透過表示と反射表示のバランスをとることが可能になり、透過表示と反射表示の双方において良好なカラー品位を実現することができる。開口率が上記範囲を下回ると、透過表示の明度を確保する必要から消費電力が増大するので携帯電話等の携帯型電子機器には採用しにくくなる。また、開口率が上記範囲を上回ると、反射表示における明度と彩度の両立が困難になり、反射表示におけるカラー品位を確保することが難しくなる。

【0054】

【発明の実施の形態】次に、添付図面を参照して本発明に係る電気光学装置、カラーフィルタ基板及び電子機器の実施形態について詳細に説明する。

【0055】〔第1実施形態〕図1は、本発明に係る第1実施形態の電気光学装置を構成する液晶パネル200の外観を示す概略斜視図であり、図2(a)は、液晶パネル200の模式的な概略断面図、図2(b)は、液晶パネル200を構成するカラーフィルタ基板210の拡

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大部分平面図である。

【0056】この電気光学装置は、いわゆる反射半透過方式のパッシブマトリクス型構造を有する液晶パネル200に対して、必要に応じて図示しないバックライトやフロントライト等の照明装置やケース体などを適宜に取付けてなる。

【0057】図1に示すように、液晶パネル200は、ガラス板や合成樹脂板等からなる透明な第1基板211を基体とするカラーフィルタ基板210と、これに対向する同様の第2基板221を基体とする対向基板220とがシール材230を介して貼り合わせられ、シール材230の内側に注入口230aから液晶232が注入された後、封止材231にて封止されてなるセル構造を備えている。

【0058】第1基板211の内面(第2基板221に対向する表面)上には複数並列したストライプ状の透明電極216が形成され、第2基板221の内面上には複数並列したストライプ状の透明電極222が形成されている。また、上記透明電極216は配線218Aに導電接続され、上記透明電極222は配線228に導電接続されている。透明電極216と透明電極222とは相互に直交し、その交差領域はマトリクス状に配列された多数の画素を構成し、これらの画素配列が液晶表示領域Aを構成している。

【0059】第1基板211は第2基板221の外形よりも外側に張り出してなる基板張出部210Tを有し、この基板張出部210T上には、上記配線218A、上記配線228に対してシール材230の一部で構成される上下導通部を介して導電接続された配線218B、及び、独立して形成された複数の配線パターンからなる入力端子部219が形成されている。また、基板張出部210T上には、これら配線218A、218B及び入力端子部219に対して導電接続されるように、液晶駆動回路等を内蔵した半導体IC261が実装されている。また、基板張出部210Tの端部には、上記入力端子部219に導電接続されるように、フレキシブル配線基板263が実装されている。

【0060】この液晶パネル200において、図2に示すように、第1基板211の外面には位相差板(1/4波長板)240及び偏光板241が配置され、第2基板221の外面には位相差板(1/4波長板)250及び偏光板251が配置されている。

【0061】<カラーフィルタ基板210の構造>次に、図2(a)及び(b)を参照して、カラーフィルタ基板210の構造を詳細に説明する。第1基板211の表面には反射層212が形成され、上記画素毎に開口部212aが設けられている。この反射層212のうち、開口部212a以外の部分が実質的に光を反射する反射部212bである。本実施形態の場合には画素毎に開口部212aと反射部212bとを有する反射層212が

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形成されている。もともと、反射層212を液晶表示領域A全体に形成し、開口部212aのみを画素毎に形成してもよい。

【0062】反射層212の上には着色層214が形成され、その上を透明樹脂等からなる表面保護層(オーバーコート層)215が被覆している。この着色層214と表面保護層215とによってカラーフィルタが形成される。

【0063】着色層214は、通常、透明樹脂中に顔料や染料等の着色材を分散させて所定の色調を呈するものとされている。着色層の色調の一例としては原色系フィルタとしてR(赤)、G(緑)、B(青)の3色の組合せからなるものがあるが、これに限定されるものではなく、補色系その他の種々の色調で形成できる。通常、基板表面上に顔料や染料等の着色材を含む感光性樹脂からなる着色レジストを塗布し、フォトリソグラフィ法によって不要部分を除去することによって、所定のカラーパターンを有する着色層を形成する。ここで、複数の色調の着色層を形成する場合には上記工程を繰り返す。

【0064】なお、着色層の配列パターンとして、図2(b)に示す図示例ではストライプ配列を採用しているが、このストライプ配列の他に、デルタ配列や斜めモザイク配列等の種々のパターン形状を採用することができる。また、上記RGBの各着色層の周囲には、着色層の一部として、画素間領域の遮光を行うための遮光膜(ブラックマトリクス或いはブラックマスク)を形成することができる。

【0065】表面保護層215の上には、ITO(インジウムスズ酸化物)等の透明導電体からなる透明電極216が形成されている。透明電極216は図2(b)の図示上下方向に伸びる帯状に形成され、複数の透明電極216が相互に並列してストライプ状に構成されている。透明電極216の上にはポリイミド樹脂等からなる配向膜217が形成されている。

【0066】本実施形態においては、図2(b)に示すように、カラーフィルタを構成する着色層214が、各画素内において反射層212の開口部212aを完全に覆うように平面的に重なっていると同時に、開口部212aと平面的に重なる領域から周囲へ向けて、開口部212aの周囲の反射部212b上に張り出すように一体に形成されている。

【0067】また、着色層214は、各画素全体に形成されているのではなく、反射層212の一部にのみ重なるように形成されている。すなわち、反射層212には、着色層214と平面的に重なる領域(図示例では開口部212aに臨む内周領域)と、着色層214と平面的に重ならない領域(図示例では外周領域)とが存在する。

【0068】一方、上記液晶パネル200において、上記カラーフィルタ基板210と対向する対向基板220

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は、ガラス等からなる第2基板221上に、上記と同様の透明電極222、SiO₂やTiO₂などからなる硬質保護膜223、上記と同様の配向膜224を順次積層させたものである。

【0069】以上のように構成された本実施形態において、対向基板220側から反射部212bに入射した外光は一部が着色層214を透過した後反射部212bにて反射し、一部が着色層214を通過することなく反射部212bにて反射し、再び対向基板220を透過して出射する。このとき、着色層214を透過する外光は着色層214を2回通過するが、着色層214を透過しない外光は着色層214を通過することなく出射する。したがって、着色層214が画素内の反射層212全体を覆っている場合に較べて反射型表示の明度を向上させることができる。

【0070】一方、着色層214は反射層212の開口部212aを全て覆っているため、例えばカラーフィルタ基板210の背後にバックライト等を配置して、背後から照明光を照射した場合には、当該照明光の一部が開口部212aを通過して着色層214を透過し、液晶232及び対向基板220を通過して出射する。したがって、透過光は着色層214を1回だけ透過するため、着色層214の色濃度（光を透過させた場合に可視光領域のスペクトル分布に偏りを与える度合）に応じた透過型表示の色彩が得られる。このとき、反射光の彩度は上記のように着色層を通過しない反射光成分が含まれているために低下するので、透過型表示の彩度は相対的に高まる。

【0071】本実施形態では、着色層214の光学的特性を透過型表示に対応するように形成し、着色層214と平面的に重なる反射部212bの反射面積を調整することにより、反射型表示の色彩、特に明度、を確保することができる。したがって、反射型表示の明るさを確保しながら透過型表示の彩度を高めることができる。また、反射型表示と透過型表示との色彩（特に彩度と明度）の差異を低減することもできる。

【0072】上記の効果は、通常カラーフィルタの製造工程と同様に、着色層を全体的にほぼ一様な色濃度に（例えば顔料や染料等の着色材の濃度をほぼ一様に）形成するとともに、着色層を全体的にほぼ一様な厚さに形成する場合に特に好適である。この場合には、着色層214における開口部212aに平面的に重なる領域と、着色層214における反射部212bに平面的に重なる領域との光学的特性がほぼ一致するので、従来構造では反射型表示の色彩と透過型表示の色彩との間に必然的に大きな彩度や明度の相違が生ずるから、本発明の効果が特に顕著なものとなる。

【0073】反射型表示と透過型表示にはそれぞれに適した色彩の発色態様があり、それぞれに別個のカラーフィルタを設けることができるのであればよいが、実際に

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は、共通のカラーフィルタで双方の表示を実現することが製造上好ましい。本実施形態では、上記のように反射着色比と透過着色比とを相互に変えることによって、着色層が共通であっても反射型表示の着色態様と透過型表示の着色態様とを別々に設定することが可能になった。

【0074】【第2実施形態】次に、図3(a)及び(b)を参照して本発明に係る第2実施形態について説明する。この実施形態の液晶パネル300では、上記第1実施形態と同様の第1基板311、第2基板321、着色層314、表面保護層315、透明電極316、配向膜317、透明電極322、硬質保護膜323、配向膜324、シール材330、液晶332、位相差板340、350、偏光板341、351を有しているので、これらについては説明を省略する。

【0075】本実施形態の液晶パネル300においては、反射層312が液晶表示領域内にほぼ全面的に一体に形成されており、画素毎に開口部312aが設けられている。この反射層312のうち、開口部312a以外の部分が実質的に光を反射する反射部312bである。また、画素間領域には黒色樹脂等からなる黒色遮光膜314BMが形成されている。黒色樹脂としては、黒色の顔料や染料等の着色材を透明樹脂中に分散させたもの、或いは、R（赤）、G（緑）及びB（青）の3色の着色材を共に混合させて透明樹脂中に分散させたものなどが用いられる。

【0076】本実施形態では反射層312を複数の画素に亘って一体に形成されたものとしたが、第1実施形態のように画素毎に反射層を形成し、反射層の間に上記黒色遮光膜を形成してもよい。

【0077】【第3実施形態】次に、図4(a)及び(b)を参照して本発明に係る第3実施形態について説明する。この実施形態の液晶パネル400は、上記第2実施形態と同様の第1基板411、第2基板421、開口部412aと反射部412bとを有する反射層412、透明電極416、配向膜417、透明電極422、配向膜423、シール材430、液晶432、位相差板440、450、偏光板441、451を有しているので、これらについては説明を省略する。

【0078】本実施形態においては、図4(a)に示すように、反射層412の形成された第1基板421ではなく、第2基板421上にカラーフィルタが形成されている。より具体的には、第2基板421上には着色層424が画素毎に形成され、画素間領域には第2実施形態と同様の黒色遮光膜424BMが形成されている。着色層424及び黒色遮光膜424BMの上には透明な表面保護層425が形成されている。

【0079】上記表面保護層425上には透明電極422が形成され、この透明電極422の上には配向膜423が形成されている。

【0080】図4(b)に示すように、反射層412の

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形成された反射基板410に対して、カラーフィルタ基板420の着色層424（図示一点鎖線）は、反射層412の開口部412aと平面的に重なり、開口部412aを完全に覆うように構成されている。また、着色層424は開口部412aと平面的に重なる領域から周囲に向けて反射層412の反射部412bと重なる領域に張り出すように一体に構成されている。すなわち、反射層412は、着色層424と平面的に重なる領域（図示例では内周領域）と、着色層424と平面的に重ならない領域（図示例では外周領域）とを備えている。

【0081】本実施形態のように反射層412と着色層424とが異なる基板上に形成されていても、反射層412と着色層424の平面的な重なり態様が上記のように構成されていれば、第1実施形態及び第2実施形態と同様の作用効果を奏することができる。

【0082】[その他の構成例] 次に、図5(a)～(d)及び図6(a)～(d)を参照して、上記各実施形態に適用可能なその他の構成例について説明する。以下に説明する各構成例では、反射層と着色層との平面的な位置関係についてのみ図示し、説明する。

【0083】（構成例1） 図5(a)に示す構成例1においては、各画素において、開口512aを備えた反射層512上に、R（赤）の色相を呈する着色層514rと、G（緑）の色相を呈する着色層514gと、B（青）の色相を呈する着色層514bとがそれぞれ平面的に重なるように形成されている。この構成例では、上記各実施形態と同様に、各画素内の着色層514r、514g、514bがそれぞれ開口部512aを完全に覆うように構成され、開口部512aと平面的に重なる領域から周囲の反射面と平面的に重なる領域に張り出すように、一体に構成されている。

【0084】（構成例2） 図5(b)に示す構成例2においては、各画素において、開口部612aを備えた反射層612上に、R（赤）の色相を呈する着色層614rと、G（緑）の色相を呈する着色層614gと、B（青）の色相を呈する着色層614bとがそれぞれ平面的に重なるように形成されている。この構成例では、各着色層614r、614g、614bが開口部612aを完全に覆ってはならず、開口部612aの一部に着色層と平面的に重ならない領域が存在する。

【0085】この構成例2では、反射型表示と透過型表示との色彩の差異を低減させるために、反射着色比（反射層612の全反射面積に対する着色層と平面的に重なる領域の面積比）が透過着色比（開口部612aの全開口面積に対する着色層と平面的に重なる領域の面積比）よりも小さくなるように構成されている。この結果、反射表示の明度は向上し、透過型表示の彩度は相対的に高まる。

【0086】（構成例3） 図5(c)に示す構成例3においては、各画素において、開口部712aを備えた

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反射層712上にそれぞれ平面的に重なるように、それぞれ複数の、R（赤）の色相を呈する着色層714r、715r、716rと、G（緑）の色相を呈する着色層714g、715g、716gと、B（青）の色相を呈する着色層714b、715b、716bとが形成されている。

【0087】この構成例では、着色層714r、714g、714bが開口部712aと平面的に重なり、それ以外の着色層715r、715g、715b、716r、716g、716bが反射層712の反射面上にのみ平面的に重なるように構成されている。このように各画素においてそれぞれ複数の着色層が平面的に重なるように構成されていても構わない。

【0088】（構成例4） 図5(d)に示す構成例4においては、開口部812aを備えた反射層812上に、R（赤）の色相を呈する着色層814rと、G（緑）の色相を呈する着色層814gと、B（青）の色相を呈する着色層814bとがそれぞれ平面的に重なるように形成されている。この構成例では、着色層812r、812g、812bが相互に異なった面積になるように構成され、その結果、反射着色比（画素内の全反射面積に対する着色層と平面的に重なった反射面積の比）が、着色層の色相R（赤）、G（緑）及びB（青）に応じて相互に異なった値になっている。より一般的に言えば、上記反射着色比と、透過着色比（画素内の全開口面積に対する着色層と平面的に重なった開口面積の比）との比が色毎に相互に異なった値となっている。

【0089】本構成例4によれば、上記実施形態や他の構成例のように反射型表示と透過型表示の色彩を別々に設定できるだけでなく、上記反射着色比（或いは反射着色比と透過着色比との比）を色毎に設定することにより、各色の着色層の材質に応じて適切な色彩を得ることができる。

【0090】（構成例5） 図6(a)に示す構成例5においては、反射層912において画素毎に複数（図示例では2つ）の開口部912aが設けられている。この反射層912のうち、開口部912a以外の部分が実質的に光を反射する反射部912bである。そして、この反射層912と平面的に重なる着色層914r、914g、914bは、それぞれ複数の開口部912aを覆うとともに、反射部912bの一部のみに平面的に重なるように構成されている。

【0091】（構成例6） 図6(b)に示す構成例6においては、開口部1012aと反射部1012bとを有する反射層1012と平面的に重なる複数（図示例では3つ）の着色層1014r、1014g、1014b、1015r、1015g、1015b、1016r、1016g、1016bが設けられている。ここで、着色層1014r、1014g、1014bは開口部1012aと平面的に重なるように構成され、着色層

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1015r, 1015g, 1015b, 1016r, 1016g, 1016bは反射部の一部にのみ平面的に重なるように構成されている。そして、着色層1014r, 1014g, 1014bは着色層1015r, 1015g, 1015b, 1016r, 1016g, 1016bよりも高い色濃度を有するように、すなわち、顔料や染料等の着色材をより高濃度に含むように、構成されている。

【0092】この構成例6では、開口部1012aと平面的に重なる着色層1014r, 1014g, 1014bの光濃度が高く、反射部1012bの一部にのみ平面的に重なるように構成された着色層1015r, 1015g, 1015b, 1016r, 1016g, 1016bの光濃度が低いので、上記各実施形態の場合に較べて、透過光の彩度は相対的にさらに高くなり、反射光はさらに明るくなる。

【0093】以上のように、本発明においては、着色層の光濃度が部分的に異なるように構成する場合を排除しない。特に、着色層については、反射層の光学的開口と平面的に重なる領域の光濃度を高く、それ以外の反射層と平面的に重なる領域の光濃度を低くすることが望ましい。

【0094】（構成例7） 図6（c）に示す構成例7においては、開口部1112aと反射部1112bとを有する反射層1112と平面的に重なる複数（図示例では2つ）の着色層1114r, 1114g, 1114b, 1115r, 1115g, 1115bが設けられている。着色層1114r, 1114g, 1114bと着色層1115r, 1115g, 1115bとは相互に積層配置されているか、或いは、相互に平面的に重なるように別々に配置されている。なお、図6（d）は、この構成例7において、反射層1112、着色層1114r, 1114g, 1114b及び着色層1115r, 1115g, 1115bを相互に積層して形成させた場合の断面図を示すものである。

【0095】この構成例7においては、着色層1114r, 1114g, 1114bと着色層1115r, 1115g, 1115bとが平面的に重なる領域、すなわち、開口部1112aと平面的に重なる領域においては、着色層の厚さが実質的に厚く、着色層1114r, 1114g, 1114bが形成されている領域内であって着色層1115r, 1115g, 1115bと平面的に重ならない領域、すなわち反射部1112bと平面的に重なる領域においては、着色層の厚さが実質的に薄くなるように構成されている。したがって、透過光の彩度は厚い着色層によってさらに向上し、反射光の明度は薄い着色層が部分的に形成されていることによりさらに向上する。

【0096】以上のように、本発明においては、着色層が部分的に厚さを変えて形成されている場合を排除する

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ものではない。特に、着色層については、反射層の光学的開口と平面的に重なる領域において実質的に厚く、それ以外の反射層と平面的に重なる領域において実質的に薄く形成することが望ましい。

【0097】ここで、上記効果をより高めるために、開口部1112aと平面的に重なる着色層1115r, 1115g, 1115bの色濃度を高く、開口部1012aと平面的に重なる領域から反射面の一部に平面的に重なる領域に張り出すように構成された着色層1114r, 1114g, 1114bの色濃度を低くしてもよい。

【0098】（構成例8） 図7には構成例8の構成を模式的に示す。この構成例8では、R画素及びB画素においては反射層1212上に全面的に着色層1214r, 1214bが形成されているが、G画素においては反射層1212の一部にのみ重なるように着色層1214gが形成されている。着色層1214gは、開口部1212aを全面的に覆うとともに、その開口縁に張り出すように広がり、これによって着色層1214gは反射部1212bの一部にのみ重なるように構成される。

【0099】この構成例8においては、反射層1212の開口率（反射層1212の全面積に対する開口部1212aの面積の比）は、RGB各画素に共通で30～70%である。また、G画素の被覆面積率（反射部1212bの面積に対する着色層1214gの面積の比）は40～80%である。

【0100】上記のように構成することにより、R画素及びB画素においては反射部1212bに対する着色層1214r, 1214bの被覆面積率（反射部1212の面積に対する反射部1212に重なる着色層の面積の比、すなわち反射着色比）を100%とすることで彩度を確保し、また、G画素においては反射部1212bに対する着色層1214gの被覆面積率を低くすることによって明度を高めるようにしている。このようにすると、R及びBの彩度を実質的にあまり低下させることなく、反射表示の明るさを高めることが可能になる。

【0101】（構成例9） 図8には、構成例9の構成を模式的に示す。この構成例9においては、B画素では反射層1312上を全面的に着色層1314bが被覆し（被覆面積率100%）、R画素では着色層1314rが反射層1312の一部を露出する開口部1314raを備えている。さらに、G画素では着色層1314gが反射層1312の開口部1312aと完全に重なるとともに、その周囲に張り出すように構成されて反射部1312b上の一部にのみ重なっている。

【0102】また、この構成例9においては、反射層1312の開口率は、RGB各画素に共通で30～70%である。また、R画素の被覆面積率は60～100%、G画素の被覆面積率は40～80%である。

【0103】（構成例10） 図9には、構成例10の

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構成を模式的に示す。この構成例10においては、B画素では反射層1412上を全面的に着色層1414bが被覆し(被覆面積率100%)、R画素では着色層1414rが反射層1412の一部を露出する開口部1414raを備えている。この例では開口部1414raは2つ設けられている。さらに、G画素では着色層1414gが反射層1412の開口部1412aと完全に重なるとともに、その周囲に張り出すように構成されて反射部1412b上の一部にのみ重なっている。

【0104】また、この構成例10においては、反射層1412の開口率は、RGB各画素に共通で30~70%である。また、R画素の被覆面積率は60~100%、G画素の被覆面積率は40~80%である。

【0105】(構成例11) 図10には、構成例11の構成を模式的に示す。この構成例11においては、B画素では着色層1514bが反射層1512の一部を露出する開口部1514baを備えている。この例では開口部1514baは2つ設けられている。また、R画素では着色層1514rが反射層1512の一部を露出する開口部1514raを備えている。この例では開口部1514raは2つ設けられている。さらに、G画素では着色層1514gが反射層1512の開口部1512aと完全に重なるとともに、その周囲に張り出すように構成されて反射部1512b上の一部にのみ重なっている。

【0106】また、この構成例11においては、反射層1512の開口率は、RGB各画素に共通で30~70%である。また、B画素の被覆面積率は70~100%、R画素の被覆面積率は60~100%、G画素の被覆面積率は40~80%である。

【0107】(構成例12) 図11には、構成例12の構成を模式的に示す。この構成例12においては、B画素では着色層1614bが反射層1612の一部を露出する開口部1614baを備えている。この例では開口部1614baは2つ設けられている。また、R画素では着色層1614rが反射層1612の一部を露出する開口部1614raを備えている。この例では開口部1614raは2つ設けられている。さらに、G画素では着色層1614gが反射層1612の開口部1612aと完全に重なるとともに、その周囲に張り出すように構成されて反射部1612b上の一部にのみ重なっている。

【0108】また、この構成例12においては、反射層1612の開口率は、RGB各画素に共通で30%である。また、B画素の被覆面積率は65.3%、R画素の被覆面積率は65.3%、G画素の被覆面積率は30.2%である。

【0109】(構成例13) 図12には、構成例13の構成を模式的に示す。この構成例13においては、B画素では着色層1714bが反射層1712の一部を露

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出する開口部1714baを備えている。この例では開口部1714baは2つ設けられている。また、R画素では着色層1714rが反射層1712の一部を露出する開口部1714raを備えている。この例では開口部1714raは2つ設けられている。さらに、G画素では着色層1714gが反射層1712の開口部1712aと完全に重なるとともに、その周囲に張り出すように構成されて反射部1712b上の一部にのみ重なっている。

【0110】また、この構成例13においては、反射層1712の開口率は、RGB各画素に共通で30%である。また、B画素の被覆面積率は75.4%、R画素の被覆面積率は75.4%、G画素の被覆面積率は40.2%である。

【0111】(構成例14) 図13には、構成例14の構成を模式的に示す。この構成例14においては、B画素では着色層1814bが反射層1812の一部を露出する開口部1814baを備えている。この例では開口部1814baは2つ設けられている。また、R画素では着色層1814rが反射層1812の一部を露出する開口部1814raを備えている。この例では開口部1814raは2つ設けられている。さらに、G画素では着色層1814gが反射層1812の開口部1812aと完全に重なるとともに、その周囲に張り出すように構成されて反射部1812b上の一部にのみ重なっている。

【0112】また、この構成例14においては、反射層1812の開口率は、RGB各画素に共通で50%である。また、B画素の被覆面積率は75.4%、R画素の被覆面積率は75.4%、G画素の被覆面積率は47.7%である。

【0113】(構成例15) 図14には、構成例15の構成を模式的に示す。この構成例15においては、各画素の反射層1912は、左右一対の反射部1912bが分離された状態で設けられ、その間に開口部1912aが形成される。また、B画素及びR画素では着色層1914b、1914rが反射層1912を全面的に被覆している。さらに、G画素では着色層1914gが反射層1912の開口部1912aと完全に重なるとともに、その周囲に張り出すように構成されて反射部1912b上の一部にのみ重なっている。すなわち、反射部1912bは、着色層1914gに設けられた開口部1914gaにより部分的に露出した状態となっている。

【0114】また、この構成例15においては、反射層1912の開口率は、RGB各画素に共通で70%である。また、B画素及びR画素の被覆面積率は100%、G画素の被覆面積率は50.0%である。

【0115】(光学特性) 次に、上記の構成例8乃至構成例11の光学特性を図15に示す。図15は、1931CIEのxyz表色系におけるxy色度図上におい

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て、上記各構成例のRGB画素の透過光及び反射光の色データを示すものである。一般に、xy色度図においては、図16に示すように、可視光領域の単波長光の色味（色相及び彩度）を境界線とする釣鐘形状の範囲内に現実に視認される色味が配置されるようになっている。また、3色（例えばRGB）の着色層を用いてカラー表示を行う場合には、各着色層RGBのデータ点を結ぶことによって形成される3角形内の色味を形成することが可能である。基本的には上記3角形の面積が大きい程カラー表示の品位が向上することになる。

【0116】図15には、上記構成例8～11の透過表示の色データ（図示一点鎖線で囲まれたデータ点）と、反射表示の色データ（図示二点鎖線で囲まれたデータ点）とを併記してある。ここで、菱形は構成例8のデータ点を、正方形は構成例9のデータ点を、三角形は構成例10のデータ点を、×印は構成例11のデータ点を示す。また、図示Hは白色表示のデータ点を示す。

【0117】図15においては、上記構成例の色データと比較するために、反射層の開口率を30%とし、RGB各色に対してそれぞれ開口部に重なる透過部着色層と、反射部に重なる反射部着色層とを別々に形成し、6回のパターンニングを行う6段プロセスにて形成したカラーフィルタ基板を用いた場合についても測定し、比較例として図示黒点で示してある。ここで、図17(a)には上記透過部着色層の分光透過率を示し、図17(b)には上記反射部着色層の分光透過率を示す。透過領域（開口部）では光は1回のみ透過部着色層を透過するのに対して、反射領域（反射部）では光は往復するために2回反射部着色層を透過するため、透過部着色層は図17(a)に示すように比較的彩度の高い光学特性を示す（平均透過率Tは低い）ものを採用し、反射部着色層は図17(b)に示すように比較的彩度が低い平均透過率Tは高い光学特性を示すものを採用している。これにより、透過表示の彩度を確保しつつ、反射表示の明るさを向上できる。

【0118】本発明に係る構成例8～11においては、上記6段プロセスの比較例の透過部着色層と同一の光学特性、すなわち図17(a)に示す分光透過率を呈する着色層を用いた。その結果、図15に示すように、上記比較例に近い反射表示のカラー品位を得ることができた。特に、構成例11は、上記比較例と実質的にほぼ等しい色相及び彩度を有する構成となっている。このように、本発明においては、透過領域と反射領域のフィルタ部分の光学特性を別々に設定する場合と同等のカラー品位を実現することができる。そして、上記比較例に対しては、RGB各色についてそれぞれ2回ずつのパターンニング（例えばフォトリソグラフィ・プロセス）を必要としないので、製造コストを大幅に低減できるという利点を有する。

【0119】上記構成例8～15に示すように、前記反

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射層の開口部の面積は、異なる色の前記着色層を備えた前記画素間で同一に構成されていることが好ましい。これは、反射層の開口部の面積が異なる色の着色層を備えた画素間で同一に構成されていることにより、各色の画素において入射光量を等しくすることができるため、透過表示の色調整を比較的簡単に行うことが可能になるからである。例えば、透過領域を構成する開口面積がRGB各色で相互に同一であるため、色の発現態様は透過型表示装置と同様であるから、RGB各色の着色層について、透過型表示装置に用いられるカラーフィルタの色材を基準にして適宜調整して色材の光学特性を設定することができる。また、反射部の面積についても異なる色の着色層を備えた画素間で同一に構成されるので、反射表示の色調整を行う際に、各色に対する着色層の反射部上の面積を調整しやすくなる。例えば、反射領域を構成する反射部面積がRGB各色で相互に同一であるため、色の発現態様は反射型表示装置と同様であるから、RGB各色の着色層について、反射型表示装置に用いられるカラーフィルタを基準にして適宜調整して被覆面積率を設定することができる。

【0120】上記構成例では、前記着色層の前記反射部上の被覆面積率は、少なくとも2つの異なる色の前記着色層を備えた前記画素間で異なっている。これにより、開口部の透過光によって実現される透過表示の色を最適化するように各色の着色層の光学特性を調整するとともに、反射部と重なる各色の着色層の被覆面積率を調整することにより反射表示の色を最適化するということが可能になる。したがって、各色についてそれぞれ透過表示の色と反射表示の色とを独立に調整することができる。

【0121】赤、緑、青の各色の着色層を備えている場合には、緑の着色層の被覆面積率を赤及び青の着色層の被覆面積率よりも小さくすることにより、反射表示における彩度の低下を抑制しつつ明るさを向上することができる。透過表示は、開口部と重なる領域において着色層を1回だけ透過した光により構成されるが、反射表示は、反射部と重なる領域において着色層を2回透過する光により主として構成され、開口部と重なる領域にある着色層の部分で反射された反射光にも部分的に影響されるので、一般的に反射表示は透過表示よりも彩度が高くなる反面、暗くなりやすい。したがって、反射表示においては、着色層の光学特性として、彩度を多少低下させても、明度を高める必要がある。

【0122】ところが、特に、比視感度は波長555nmでピークを有することから同じ光エネルギー量であっても緑色や黄色は赤色や青色よりも明るく見えることになるため、各色毎に彩度と明度との関係は異なる。例えば、赤（R画素）や青（B画素）の着色層を明るくするためには、赤や青の波長域の光エネルギーを大幅に増大させない限り、赤や青以外の光（比視感度の高い緑色や

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黄色の光)を増やすしか方法はないから、全体の光量が限られている場合には、明度の向上に値しない大幅な彩度の低下を招いてしまう。これに対して、比視感度の高い波長域を主体とする緑(G画素)の場合には彩度を上げても暗くなりにくいので、明度を高めても彩度が大幅に低下することはない。

【0123】本発明の場合には、着色層の反射部上の被覆面積率を調整することによって、反射表示における彩度と明度の両立を図っている。この場合、R画素やB画素においては、被覆面積率を大きく低下させると明るくはなるものの彩度が急激に低下するため、被覆面積率は60~100%と高く設定することが好ましい。一方、G画素においては、被覆面積率を低下させることにより、反射光に緑以外の赤や青の波長域の光が含まれることとなるが、これらの他の波長域に対して比視感度に大きな差があるためにそれほど彩度は低下しないので、被覆面積率としては35~50%と低く設定することが好ましい。緑の被覆面積率と赤及び青の被覆面積率を上記範囲に設定することにより、透過表示の色再現性を確保しつつ、反射表示の色再現性及び明度を向上させることができる。

【0124】上記構成例においてはいずれも反射部が開口部の全周囲に配置されている。すなわち、反射層において開口部が反射部により取り囲まれた状態に形成されている。したがって、着色層と反射層との間に多少の位置ずれが発生したとしても、着色層で覆われない領域が開口部に生じないようにすることができる。特に、開口部が反射層の略中央に形成されていることにより、反射層の中央部分及びその周囲に重なるように着色層を形成することができるため、パターンング誤差等に対してカラーフィルタの光学性能が影響を受け難くなり、安定した生産が可能になる。

【0125】開口部による反射層に対する開口率は30~70%であることが好ましい。一般に、反射層の開口率が大きくなると透過表示は明るくなるが、反射表示は逆に暗くなるので、透過表示と反射表示のバランスを採るように反射層の開口率を設定する必要がある。より具体的には、開口率が小さすぎると、バックライトの照度を高くする必要があり、バックライトの消費電力が増大する。また、開口率が大きすぎると、反射表示が暗くなり視認しにくくなる。本実施形態では、反射部の一部に着色層と重ならない領域が設けられることにより反射表示の明るさをかせぐことができるので、反射層全体に着色層を重ねた構造を採用する場合に較べて、開口率が大きい上記範囲で透過表示と反射表示のバランスをとることが可能になり、透過表示と反射表示の双方において良好なカラー品位を実現することができる。開口率が上記範囲を下回ると、透過表示の明度を確保する必要から消費電力が増大するので携帯電話等の携帯型電子機器には採用しにくくなる。また、開口率が上記範囲を上回る

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と、反射表示における明度と彩度の両立が困難になり、反射表示におけるカラー品位を確保することが難しくなる。

【0126】〔電子機器の実施形態〕上記液晶パネルを含む電気光学装置を電子機器の表示装置として用いる場合の実施形態について説明する。図18は、本実施形態の全体構成を示す概略構成図である。ここに示す電子機器は、上記と同様の液晶パネル200と、これを制御する制御手段1200とを有する。ここでは、液晶パネル200を、パネル構造体200Aと、半導体IC等で構成される駆動回路200Bとに概念的に分けて描いてある。また、制御手段1200は、表示情報出力源1210と、表示処理回路1220と、電源回路1230と、タイミングジェネレータ1240とを有する。

【0127】表示情報出力源1210は、ROM(Read Only Memory)やRAM(Random Access Memory)等からなるメモリと、磁気記録ディスクや光記録ディスク等からなるストレージユニットと、デジタル画像信号を同調出力する同調回路とを備え、タイミングジェネレータ1240によって生成された各種のクロック信号に基づいて、所定フォーマットの画像信号等の形で表示情報を表示情報処理回路1220に供給するように構成されている。

【0128】表示情報処理回路1220は、シリアルパラレル変換回路、増幅・反転回路、ローテーション回路、ガンマ補正回路、クランプ回路等の周知の各種回路を備え、入力した表示情報の処理を実行して、その画像情報をクロック信号CLKと共に駆動回路200Bへ供給する。駆動回路200Bは、走査線駆動回路、データ線駆動回路及び検査回路を含む。また、電源回路1230は、上述の各構成要素にそれぞれ所定の電圧を供給する。

【0129】図19は、本発明に係る電子機器の一実施形態である携帯電話を示す。この携帯電話2000は、ケース体2010の内部に回路基板2001が配置され、この回路基板2001に対して上述の液晶パネル200が実装されている。ケース体2010の前面には操作ボタン2020が配列され、また、一端部からアンテナ2030が出没自在に取付けられている。受話部2040の内部にはスピーカが配置され、送話部2050の内部にはマイクが内蔵されている。

【0130】ケース体2010内に設置された液晶パネル200は、表示窓2060を通して表示面(上記の液晶表示領域A)を視認することができるように構成されている。

【0131】尚、本発明の電気光学装置及び電子機器は、上述の図示例にのみ限定されるものではなく、本発明の要旨を逸脱しない範囲内において種々変更を加え得ることは勿論である。例えば、上記各実施形態に示す液晶パネルは単純マトリクス型の構造を備えているが、T

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FT（薄膜トランジスタ）やTFD（薄膜ダイオード）等のアクティブ素子（能動素子）を用いたアクティブマトリクス方式の液晶装置にも適用することができる。また、上記実施形態の液晶パネルは所謂COGタイプの構造を有しているが、ICチップを直接実装する構造ではない液晶パネル、例えば液晶パネルにフレキシブル配線基板やTAB基板を接続するように構成されたものであっても構わない。

【0132】上述した実施形態では、電気光学装置として、液晶装置に適用した場合について説明したが、本発明はこれに限定されず、エレクトロルミネッセンス装置、特に、有機エレクトロルミネッセンス装置、無機エレクトロルミネッセンス装置等や、プラズマディスプレイ装置、FED（フィールドエミッションディスプレイ）装置、LED（発光ダイオード）表示装置、電気泳動表示装置、薄型のブラウン管、液晶シャッター等を用いた小型テレビ、デジタルマイクロミラーデバイス（DMD）を用いた装置などの各種の電気光学装置に適用できる。

【0133】

【発明の効果】以上、説明したように本発明によれば、反射型表示の明るさを確保しつつ透過型表示の彩度を向上できる。また、反射型表示と透過型表示との間の色彩の差異を低減できる。

【図面の簡単な説明】

【図1】 本発明に係る電気光学装置の第1実施形態における液晶パネル200の外観を示す液晶パネルの概略斜視図である。

【図2】 第1実施形態の断面構造を模式的に示す概略断面図（a）及びカラーフィルタ基板の概略拡大平面図（b）である。

【図3】 本発明に係る電気光学装置の第2実施形態における液晶パネル300の断面構造を模式的に示す概略断面図（a）及びカラーフィルタ基板の概略拡大平面図（b）である。

【図4】 本発明に係る電気光学装置の第3実施形態における液晶パネル400の断面構造を模式的に示す概略断面図（a）及びカラーフィルタ基板の概略拡大平面図（b）である。

【図5】 その他の構成例1～4の反射層と着色層との重なり状態を模式的に示す概略説明図（a）～（d）である。

【図6】 その他の構成例5～7の反射層と着色層との

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重なり状態を模式的に示す概略説明図（a）～（c）、及び構成例7の概略断面図（d）である。

【図7】 本発明に係る構成例8の構成を模式的に示す概略説明図である。

【図8】 本発明に係る構成例9の構成を模式的に示す概略説明図である。

【図9】 本発明に係る構成例10の構成を模式的に示す概略説明図である。

【図10】 本発明に係る構成例11の構成を模式的に示す概略説明図である。

【図11】 本発明に係る構成例12の構成を模式的に示す概略説明図である。

【図12】 本発明に係る構成例13の構成を模式的に示す概略説明図である。

【図13】 本発明に係る構成例14の構成を模式的に示す概略説明図である。

【図14】 本発明に係る構成例15の構成を模式的に示す概略説明図である。

【図15】 構成例8～11の着色層と6段プロセスの比較例の色データとを比較して示すxy色度図である。

【図16】 1931CIExyz表色系の色度図である。

【図17】 着色層の分光透過率を示すグラフ（a）及び（b）である。

【図18】 本発明に係る電子機器の実施形態のブロック構成を示す概略構成図である。

【図19】 同電子機器の実施形態の外観を示す概略斜視図である。

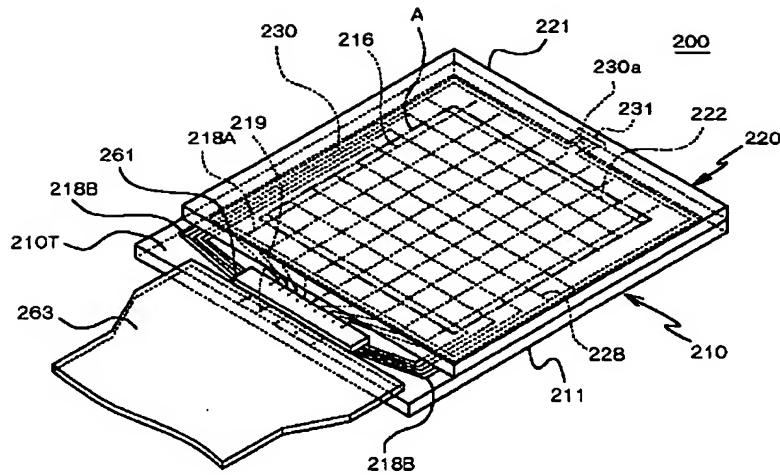
【図20】 従来の反射半透過型液晶パネルの構造を模式的に示す概略断面図である。

【符号の説明】

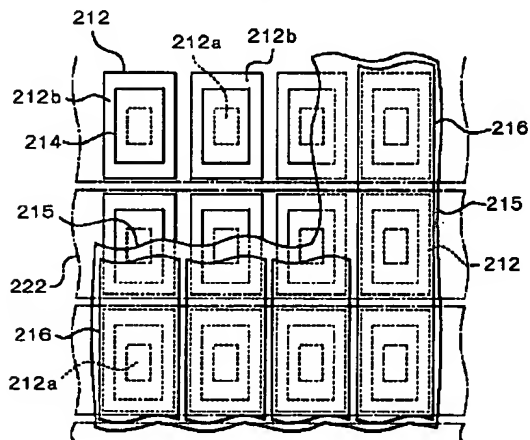
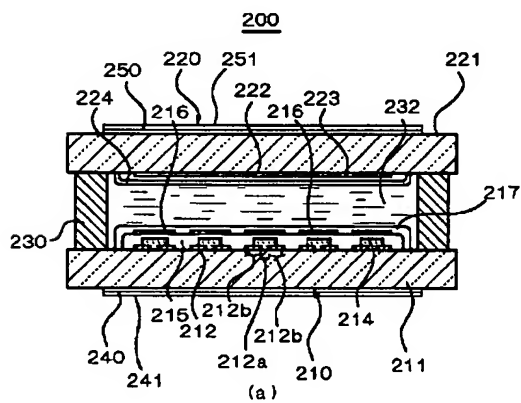
200 液晶パネル
211 第1基板
212 反射層
212a 開口部
212b 反射部
214 着色層
215 表面保護層
216 透明電極
221 第2基板
222 透明電極
230 シール材
240, 250 偏光板

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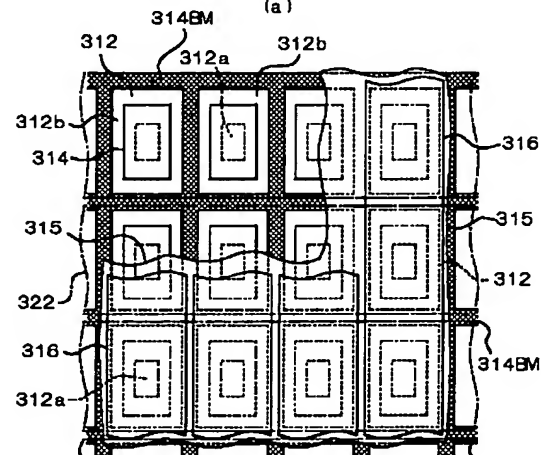
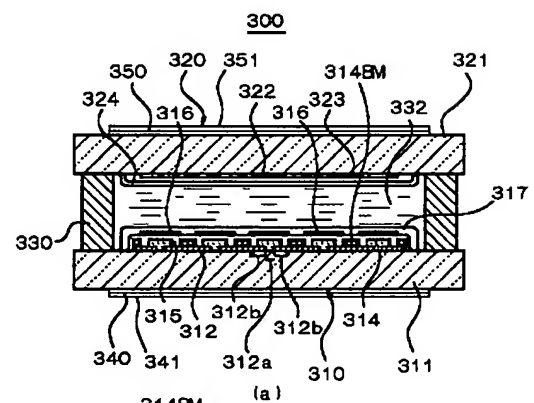
【図1】



【図2】

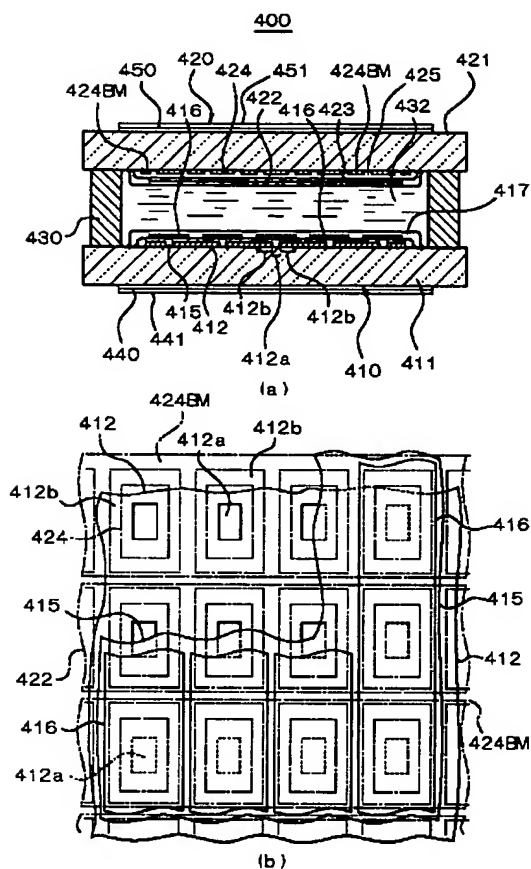


【図3】

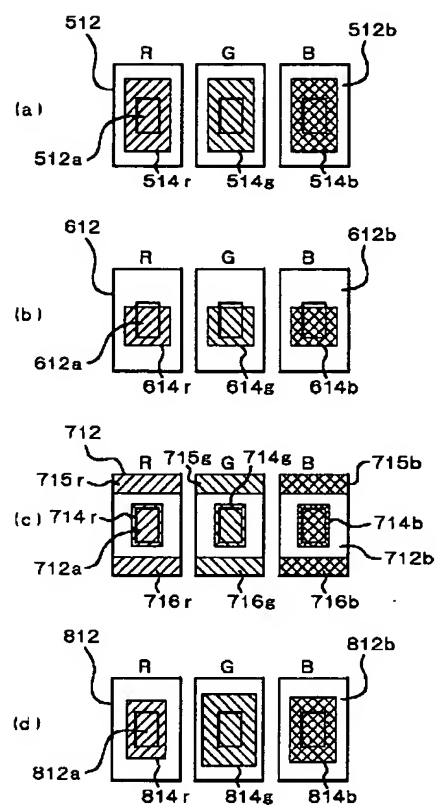


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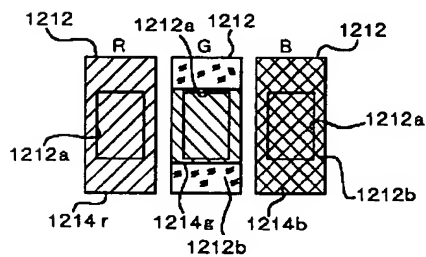
【図4】



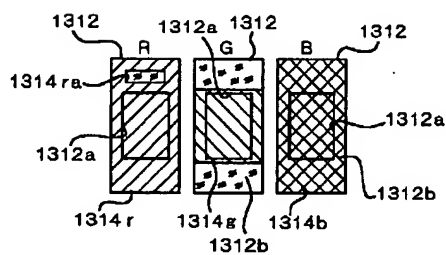
【図5】



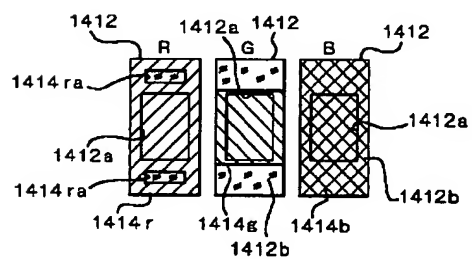
【図 7】



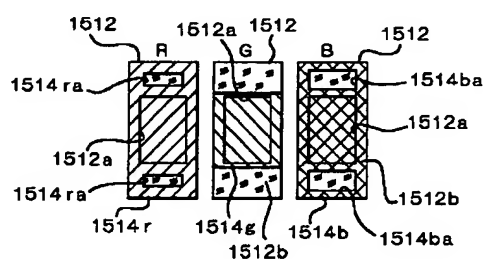
【图 8】



【図 9】

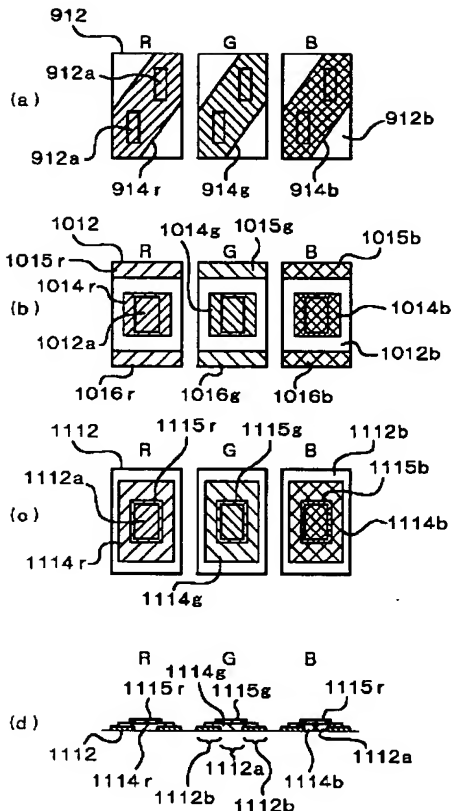


【図 10】

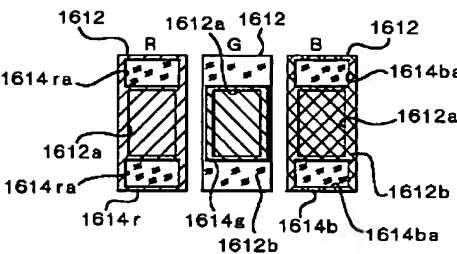


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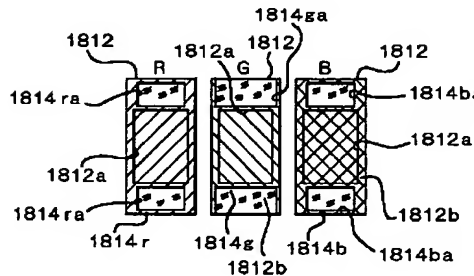
【図6】



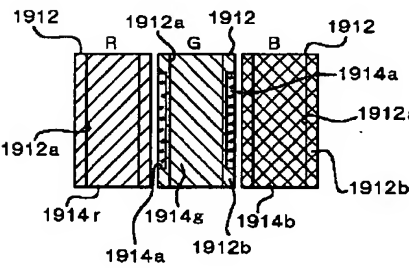
【図11】



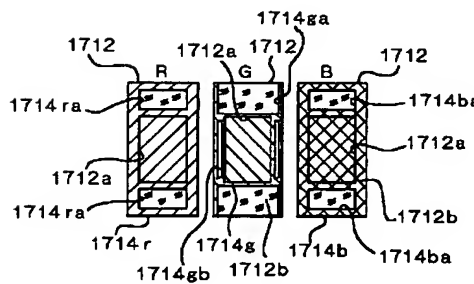
【図13】



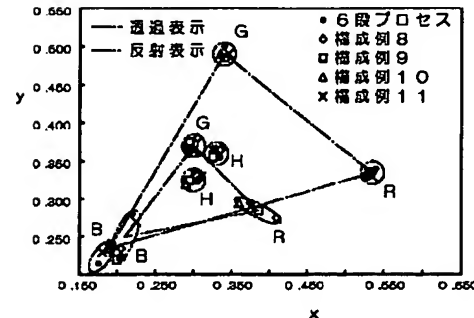
【図14】



【図12】

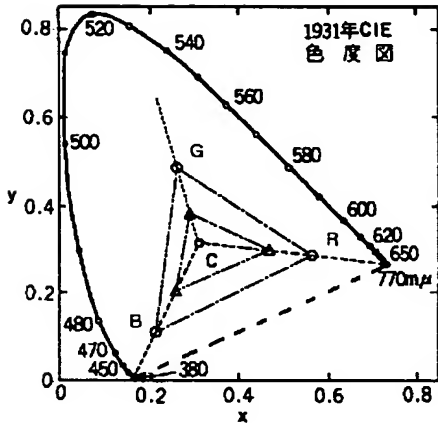


【図15】

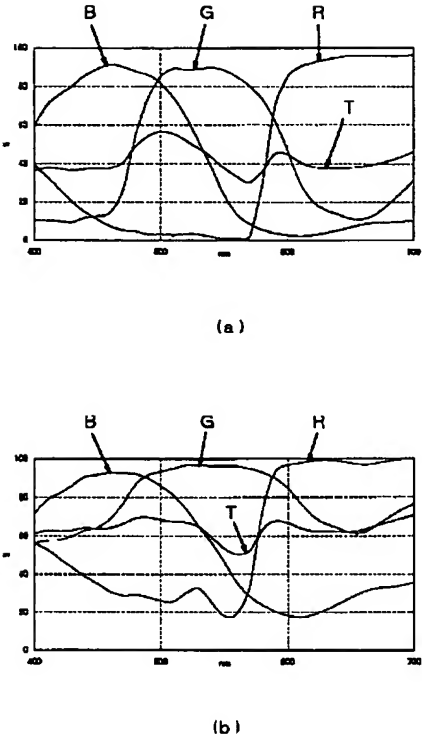


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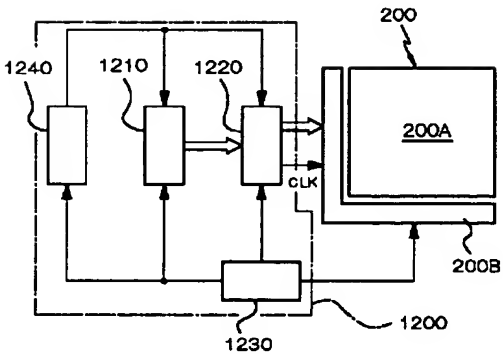
【図16】



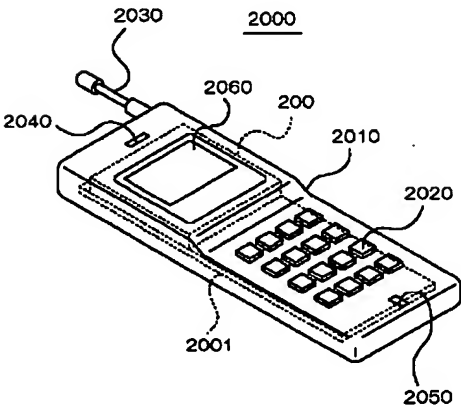
【図17】



【図18】

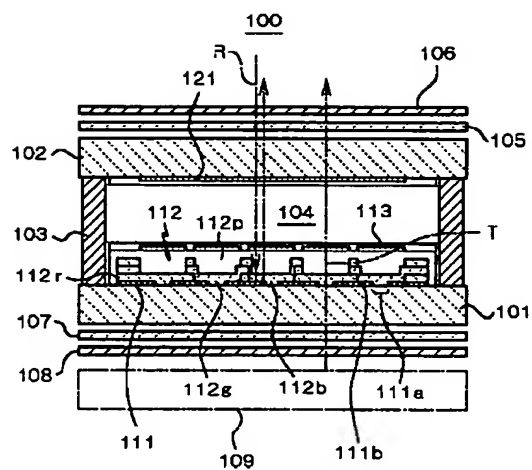


【図19】



(20)

【图20】



フロントページの続き

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BB10 BB37 BB42
2H091 FA02Y FA14Y FD04 FD06
GA01

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CLAIMS

[Claim(s)]

[Claim 1] The electrooptic material layer arranged between the substrates of a couple in an electro-optic device, The coloring layer arranged between one substrate and said electrooptic material layer among the substrates of said couple, It is the electro-optic device characterized by being arranged only in the part on said reflective section while having the reflecting layer which has the reflective section which reflects the light which passed said electrooptic material layer and said coloring layer, and opening and arranging said coloring layer on said opening.

[Claim 2] The ratio of the area of said reflective section by which said coloring layer to the area of said reflective section is arranged is an electro-optic device according to claim 1 characterized by being smaller than the ratio of the area of said opening by which said coloring layer to the area of said opening is arranged.

[Claim 3] Said coloring layer is an electro-optic device according to claim 1 or 2 characterized by being arranged so that said opening may be covered thoroughly.

[Claim 4] Said coloring layer is an electro-optic device according to claim 1 or 2 characterized by being arranged so that it may jut out of on said opening on said reflective section of said perimeter of opening.

[Claim 5] The electrooptic material layer arranged between the electrode for a display of a couple, and the electrode for a display of said couple in an electro-optic device, Two or more pixels arranged corresponding to the superficial lap field of the electrode for a display of said couple, It is arranged the coloring layer arranged in each of said pixel, and in each of said pixel. It is the electro-optic device characterized by being arranged in the part on said reflective section while having the reflecting layer which has the reflective section which reflects the light which passed said electrooptic material layer and said coloring layer, and opening and arranging said coloring layer on said opening.

[Claim 6] the electro-optic device according to claim 5 characterized by said two or more pixels being alike, respectively, and the area of said coloring layer corresponding to [the area of said corresponding opening is substantially the same mutually and] at least one of said two or more of the pixels differing from the area of said coloring layer corresponding to said two or more other pixels.

[Claim 7] The electrooptic material layer arranged on two or more pixels in an electro-optic device, Two or more kinds of coloring layers which have been arranged on said pixel and which have a color which is mutually different, While being arranged on each of said pixel, having the reflecting layer which has the reflective section which reflects the light which passed said electrooptic material layer and said coloring layer, and opening and arranging said coloring layer on said opening and said reflective section The electro-optic device characterized by two or more said things [that said a kind of coloring / at least / layer of the coloring layers of a class is arranged only in the part on said reflective section].

[Claim 8] The area of opening of said reflecting layer is an electro-optic device according to claim 7 characterized by being identically constituted between said pixels equipped with said coloring layer of a different color.

[Claim 9] The rate of coat area on said reflective section of said coloring layer is an electro-optic device according to claim 7 characterized by differing between said pixels equipped with said coloring layer of

at least two different colors.

[Claim 10] It is the electro-optic device according to claim 9 characterized by having red, green, and said coloring layer of each blue color, and said rate of coat area of said green coloring layer being smaller than said rate of coat area of red and said blue coloring layer.

[Claim 11] It is the electro-optic device according to claim 10 which said rate of coat area of said green coloring layer is 30 - 50%, and is characterized by said rate of coat area of red and said blue coloring layer being 60 - 100%.

[Claim 12] Said reflective section is an electro-optic device according to claim 1, 5, or 7 characterized by being arranged in the perimeter enclosure of said opening.

[Claim 13] The numerical aperture to said reflecting layer by said opening is an electro-optic device according to claim 1, 5, or 7 characterized by being 30 - 70%.

[Claim 14] Electronic equipment characterized by having an electro-optic device according to claim 1, 5, or 7 and the control means which controls this electro-optic device.

[Claim 15] It is the light filter substrate characterized by being arranged only in the part on said reflective section while being arranged on a substrate and said substrate, having the reflecting layer which has the reflective section which reflects light, and opening, and the coloring layer arranged on said substrate in a light filter substrate and arranging said coloring layer on said opening.

[Claim 16] The substrate with which the pixel was set up in the light filter substrate, and the coloring layer arranged on said substrate according to said pixel, It is the light filter substrate characterized by being arranged at least in the part on said reflective section while being arranged on said substrate according to said pixel, having the reflecting layer which has the reflective section which reflects light, and opening and arranging said coloring layer on said opening.

[Claim 17] The substrate with which the pixel was set up in the light filter substrate, and two or more kinds of coloring layers which have been arranged on said substrate according to said pixel and which have a color which is mutually different, While being arranged on said substrate according to said pixel, having the reflecting layer which has the reflective section which reflects light, and opening and arranging said coloring layer on said opening and said reflective section The light filter substrate characterized by two or more said things [that said a kind of coloring / at least / layer of the coloring layers of a class is arranged only in the part on said reflective section].

[Translation done.]

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to an electro-optic device, a light filter substrate, and electronic equipment, and relates to a technique suitable as structure of a color electro-optic device of having a reflecting layer especially.

[0002]

[Description of the Prior Art] The liquid crystal display panel of a reflective transfective type whose check by looking of all of the reflective mold display using outdoor daylight and the transparency mold display using illumination light, such as a back light, was enabled from the former is known. The liquid crystal display panel of this reflective transfective type has a reflecting layer for reflecting outdoor daylight in that panel, and it constitutes it so that illumination light, such as a back light, can penetrate this reflecting layer. As this kind of a reflecting layer, there are some which were equipped with opening (slit) of predetermined area for every pixel of a liquid crystal display panel.

[0003] Drawing 20 is the outline sectional view showing typically the outline structure of the conventional liquid crystal display panel 100 of a reflective transfective type. This liquid crystal display panel 100 is equipped with the structure which the substrate 101 and the substrate 102 were stuck by the sealant 103, and enclosed liquid crystal 104 between the substrate 101 and the substrate 102.

[0004] On the inner surface of a substrate 101, the reflecting layer 111 which has opening 111a and reflective section 111b for every pixel is formed, and the light filter 112 equipped with the coloring layers 112r, 112g, and 112b and surface protective layer 112p on this reflecting layer 111 is formed. The transparent electrode 113 is formed on the front face of surface protective layer 112p of a light filter 112.

[0005] On the other hand, a transparent electrode 121 is formed on the inner surface of a substrate 102, and it is constituted so that the above-mentioned transparent electrode 113 on the substrate 101 which counters may be intersected. In addition, on a substrate 101 and a substrate 102, the orientation film, a hard transparent membrane, etc. are formed suitably if needed.

[0006] Moreover, on the outside surface of the above-mentioned substrate 102, sequential arrangement of the phase contrast plate (quarter-wave length plate) 105 and the polarizing plate 106 is carried out, and sequential arrangement of the phase contrast plate (quarter-wave length plate) 107 and the polarizing plate 108 is carried out on the outside surface of a substrate 101.

[0007] The liquid crystal display panel 100 constituted as mentioned above is attached back [the] in the condition that the back light 109 has been arranged, when installed in electronic equipment, such as a cellular phone and a personal digital assistant. In this liquid crystal display panel 100, since it is reflected in reflective section 111b, liquid crystal 104 is penetrated again and it is emitted after outdoor daylight penetrates liquid crystal 104 along a reflex path R in bright locations, such as day ranges and indoor, a reflective mold display is checked by looking. Since the light which passed opening 111a among the illumination light of a back light 109 by on the other hand making a back light 109 turn on in dark locations, such as night and the outdoors, passes the liquid crystal display panel 100 and is emitted

in accordance with the transparency path T, a transparency mold display is checked by looking.
[0008]

[Problem(s) to be Solved by the Invention] However, in order that light may pass a light filter 112 only at once in the above-mentioned transparency path T to light passing a light filter 112 twice, the lightness of a reflective mold display falls compared with the lightness of a transparency mold display, and there is a trouble that the saturation in a transparency mold display worsens to the saturation of a reflective mold display in the above-mentioned reflex path R, in the liquid crystal display panel 100 of a reflective transfective type of the above-mentioned former. When it does in this way, it becomes impossible that is, to obtain sufficient saturation in a transparency mold display, although it is necessary to set up the light transmittance of a light filter 112 highly, and to secure the brightness of a display since the brightness of a display generally tends to be insufficient in the reflective mold display.

[0009] Moreover, since the counts to which light passes a light filter in a reflective mold display and a transparency mold display as mentioned above differ and the color of a reflective mold display differs from the color of a transparency mold display greatly, there is also a trouble of giving sense of incongruity.

[0010] Then, this invention solves the above-mentioned trouble, and the technical problem is in offering the possible light filter substrate of securing both the brightness of a reflective mold display, and the saturation of a transparency mold display, when the both sides of a reflective mold display and a transparency mold display are used for the display made possible. Moreover, it is in offering the possible electro-optic device of a reflective transfective type of securing both the brightness of a reflective mold display, and the saturation of a transparency mold display. Furthermore, it aims at realizing the display technique in which the difference in the color between the transparency mold displays with a reflective mold display can be reduced.

[0011]

[Means for Solving the Problem] In order to solve the above-mentioned technical problem, this invention person found out that the brightness of the reflected light reflected by the reflecting layer concerned was securable by constituting so that a coloring layer may lap superficially with a part of reflecting layer, and constituting so that a coloring layer may not lap with the part of others of a reflecting layer.

[0012] Especially, in the case of the electro-optic device of a reflective transfective type, after preparing the reflecting layer equipped with optical opening, while it constitutes so that a coloring layer may lap with optical opening selectively at least, the saturation of a transparency mold display can be raised by constituting so that a coloring layer may lap with a part of reflecting layer, securing the brightness of a reflective mold display.

[0013] The coloring layer is beforehand set as the predetermined depth of shade, and the brightness of a reflective mold display can be secured by adjusting after that the rate that a coloring layer laps with a reflecting layer so that a transparency mold display may more specifically be obtained good, where a coloring layer is put on optical opening.

[0014] The electrooptic material layer by which the electro-optic device of this invention has been arranged between the substrates of a couple (for example, liquid crystal layer), The coloring layer arranged between one substrate and said electrooptic material layer among the substrates of said couple, While having the reflecting layer which has the reflective section which reflects the light which passed said electrooptic material layer and said coloring layer, and opening and arranging said coloring layer on said opening, it is characterized by being arranged only in the part on said reflective section.

[0015] Since such adjustment is unrelated to the lap condition of a coloring layer and optical opening while according to this invention the coloring layer is arranged on opening and it becomes possible to adjust the brightness of the reflected light by being arranged only in the part on the reflective section according to the lap rate to the reflecting layer of a coloring layer, it can avoid affecting the color of the transmitted light. Therefore, it becomes possible to set up independently the effect of the coloring layer to the reflected light, and the effect of a coloring layer to the transmitted light mutually.

[0016] As for the ratio (only henceforth a "reflective coloring ratio") of the area of the part of said

reflective section which laps with said coloring layer to the area of said reflecting layer here, it is desirable that it is smaller than the ratio (only henceforth a "transparency coloring ratio") of the area of the part of said opening which laps with said coloring layer to the area of said opening. Although the lightness of the reflected light will become lower than the transmitted light and the saturation of the transmitted light will become lower than the saturation of the reflected light if it is usual since the transmitted light which passes optical opening to the reflected light penetrating a coloring layer twice penetrates a coloring layer only once the brightness of the reflected light can be raised by making a reflective coloring ratio smaller than a transparency coloring ratio -- both the saturation of the transmitted light can be raised relatively and a difference of the color between the reflected light and the transmitted light can be reduced.

[0017] Moreover, it is desirable to be arranged so that said coloring layer may cover said opening thoroughly. By being arranged so that a coloring layer may cover optical opening thoroughly, the saturation of the transmitted light can be raised further.

[0018] Here, said reflecting layer and said coloring layer may be arranged on said one substrate among the substrates of said couple, and said reflecting layer may be arranged on said one substrate among the substrates of said couple, and said coloring layer may be arranged on the substrate of another side among the substrates of said couple. Even if it is which case, the same operation effectiveness can be acquired optically.

[0019] Moreover, as for said coloring layer, it is desirable to be arranged so that it may jut out of on said opening on said reflective section of said perimeter of opening. By arranging the coloring layer so that it may jut out of on opening on the reflective section of the perimeter, it becomes possible to form a coloring layer as a thing of one. Therefore, it becomes unnecessary to form the pattern of a coloring layer so finely, and, easier moreover, can manufacture by the high yield.

[0020] Moreover, the electrooptic material layer by which another electro-optic device of this invention has been arranged on two or more pixels, It is arranged the coloring layer arranged on each of said pixel, and on each of said pixel. While having the reflecting layer which has the reflective section which reflects the light which passed said electrooptic material layer and said coloring layer, and opening and arranging said coloring layer on said opening, it is characterized by being arranged only in the part on said reflective section.

[0021] By according to this invention, being arranged in two or more pixels, only in the part on the reflective section, while the coloring layer is arranged on opening Since such adjustment is unrelated to the lap condition of a coloring layer and optical opening while becoming possible to adjust the brightness of the reflected light for every pixel according to the lap rate to the reflecting layer of a coloring layer, it can avoid affecting the color of the transmitted light. Therefore, it becomes possible to set up independently the effect of the coloring layer to the reflected light, and the effect of a coloring layer to the transmitted light mutually for every pixel.

[0022] As for the ratio of the area of the part of said reflective section which laps with said coloring layer to the whole surface product of said reflective section in each of said pixel here, it is desirable that it is smaller than the ratio of the area of the part of said opening which laps with said coloring layer to the whole surface product of said opening. Although the lightness of the reflected light will become lower than the transmitted light and the saturation of the transmitted light will become lower than the saturation of the reflected light if it is usual since the transmitted light which passes optical opening to the reflected light penetrating a coloring layer twice penetrates a coloring layer only once by making a reflective coloring ratio smaller than a transparency coloring ratio, the brightness of the reflected light can be raised for every pixel -- both the saturation of the transmitted light can be raised relatively and a difference of the color between the reflected light and the transmitted light can be reduced for every pixel.

[0023] Moreover, it is desirable to be arranged so that said coloring layer may cover said opening thoroughly. By being arranged so that a coloring layer may cover optical opening thoroughly, the saturation of the transmitted light can be raised further.

[0024] Furthermore, it has the substrate of the couple which pinched said electrooptic material layer, and

said reflecting layer and said coloring layer may be arranged on one substrate among the substrates of said couple, and said reflecting layer may be arranged on said one substrate among the substrates of said couple, and said coloring layer may be arranged on said substrate of another side among the substrates of said couple. Even if it is which case, the same operation effectiveness can be acquired optically.

[0025] Moreover, as for said coloring layer, in each of said pixel, it is desirable to be arranged so that it may jut out of on said opening on said reflective section of said perimeter of opening. Since according to this a coloring layer can be prepared so that it may become the integral construction jutting out on said surrounding reflecting layer from the field which laps with opening superficially for every pixel, it becomes unnecessary to form the pattern of a coloring layer so finely, and, easier moreover, can manufacture by the high yield.

[0026] Moreover, the electrooptic material layer by which the electro-optic device with which this inventions differ has been arranged between the electrode for a display of a couple, and the electrode for a display of said couple, Two or more pixels arranged corresponding to the superficial lap field of the electrode for a display of said couple, It is arranged the coloring layer arranged in each of said pixel, and in each of said pixel. While having the reflecting layer which has the reflective section which reflects the light which passed said electrooptic material layer and said coloring layer, and opening and arranging said coloring layer on said opening, it is characterized by being arranged in the part on said reflective section.

[0027] In this case, the area of said opening corresponding to each of two or more of said pixels is substantially the same mutually, and it is [the area of said coloring layer corresponding to at least one of said two or more of the pixels] desirable to differ from the area of said coloring layer corresponding to said two or more other pixels.

[0028] Furthermore, the electrooptic material layer by which another electro-optic device of this invention has been arranged on two or more pixels, Two or more kinds of coloring layers which have been arranged on said pixel and which have a color which is mutually different, While being arranged on each of said pixel, having the reflecting layer which has the reflective section which reflects the light which passed said electrooptic material layer and said coloring layer, and opening and arranging said coloring layer on said opening and said reflective section It is characterized by two or more said things [that said a kind of coloring / at least / layer of the coloring layers of a class is arranged only in the part on said reflective section].

[0029] As for the area of opening of said reflecting layer, in this invention, it is desirable to be identically constituted between said pixels equipped with said coloring layer of a different color. Since the amount of incident light can be made equal in the pixel of each color by being identically constituted between the pixels equipped with the coloring layer of the color from which the area of opening of a reflecting layer differs, it becomes possible to perform color adjustment of a transparency display comparatively simply. Moreover, since it is identically constituted between the pixels equipped with the coloring layer of a color which is different also about the area of the reflective section, in case color adjustment of a reflective display is performed, it becomes easy to adjust the area on the reflective section of the coloring layer to each color.

[0030] As for the rate of coat area on said reflective section of said coloring layer (equivalent to the above-mentioned reflective coloring ratio), in this invention, it is desirable to differ between said pixels equipped with said coloring layer of at least two different colors. While adjusting the optical property of the coloring layer of each color so that this may optimize the color of the transparency display realized by the transmitted light of opening, it becomes possible to optimize the color of a reflective display by adjusting the rate of coat area of the coloring layer of each color which laps with the reflective section. Therefore, the color of a transparency display and the color of a reflective display can be independently adjusted about each color, respectively.

[0031] In this invention, it has red, green, and said coloring layer of each blue color, and, as for said rate of coat area of said green coloring layer, it is desirable that it is smaller than said rate of coat area of red and said blue coloring layer. Although a transparency display is constituted by the light which penetrated the coloring layer only once in the field which laps with opening, a reflective display is

mainly constituted by the light which penetrates a coloring layer twice in the field which laps with the reflective section, and is influenced by the reflected light by the coloring layer in the field which laps with opening selectively. Therefore, generally, a reflective display tends to become dark, while saturation becomes high rather than a transparency display. By the way, even if relative luminous efficiency raises the saturation of a green light to an yellow-green wavelength field to becoming dark if the saturation of the light of red and blue goes up since it has a peak, it cannot become dark easily. Thereby, if it is going to raise lightness in a reflective display, it will become easy for especially the saturation of red or blue to fall. therefore, the pixel of red or blue -- setting -- the rate of coat area -- high -- carrying out (or [namely, / losing the area of the reflective section which does not lap with a coloring layer] -- or) It becomes possible to increase lightness substantially, securing [lessen, secure saturation, and] the color repeatability of a reflective display, if the amount of reflected lights is earned by what the rate of coat area is made low for in a green pixel (that is, the area of the reflective section which does not lap with a coloring layer is increased).

[0032] In this invention, said rate of coat area of said green coloring layer is 30 - 50%, and, as for said rate of coat area of red and said blue coloring layer, it is desirable that it is 60 - 100%. The color repeatability and lightness of a reflective display can be raised securing the color repeatability of a transparency display by setting the green rate of coat area, red, and the blue rate of coat area as the above-mentioned range. As a rate of coat area of an especially green coloring layer, it is most desirable that it is 85 - 100% of range as a rate of coat area of red and a blue coloring layer 35 to 45%.

[0033] As for said reflective section, in this invention, being arranged in the perimeter enclosure of said opening is desirable. Since it will be formed in the condition that opening was enclosed by the reflective section in the reflecting layer, by this, even if a location gap of some occurs between a coloring layer and a reflecting layer, the field which is not covered in a coloring layer can be prevented from being generated in opening. As for said especially opening, it is desirable to be formed in the center of abbreviation of said reflecting layer.

[0034] As for the numerical aperture to said reflecting layer by said opening, in this invention, it is desirable that it is 30 - 70%. Since a reflective display will generally become conversely dark although a transparency display becomes bright if the numerical aperture of a reflecting layer becomes large, it is necessary to set up the numerical aperture of a reflecting layer so that the balance of a transparency display and a reflective display may be taken. If a numerical aperture is too small, it is necessary to make the illuminance of a back light high, and, more specifically, the power consumption of a back light will increase. Moreover, if a numerical aperture is too large, a reflective display will become dark and it will be hard coming to check by looking. since the brightness of a reflective display can work by be establish the field which do not lap with a coloring layer in a part of reflective section with this operation gestalt , it become possible and take the balance of a transparency display and a reflective display in the above-mentioned range a numerical aperture be large in the range to the whole reflecting layer compared with the case adopt the structure piled up in the coloring layer can realize good color grace in the both sides of a transparency display and a reflective display . If a numerical aperture is less than the above-mentioned range, since power consumption will increase from the need of securing the lightness of a transparency display, it is hard coming to adopt it as pocket mold electronic equipment, such as a cellular phone. Moreover, if a numerical aperture exceeds the above-mentioned range, coexistence of the lightness in a reflective display and saturation will become difficult, and it will become difficult to secure the color grace in a reflective display.
 [0035] The electronic equipment of this invention is characterized by having the electro-optic device of one of the above, and the control means which controls this electro-optic device. **s, such as the electronic equipment especially equipped with the liquid crystal display in which the color display as an electro-optic device is possible, for example, a cellular phone, a personal digital assistant, and image pick-up equipment that has a liquid crystal display function, are mentioned. By this, when using an electro-optic device as a display of electronic equipment, the difference of color with a reflective mold display and a transparency mold display can be reduced, and high display grace can be realized.

[0036] In addition, although what is necessary is to show the coloring mode of color suitable for each in

a reflective mold display and a transparency mold display, and just to be able to prepare the separate light filter in each, a common light filter must realize both displays actually. In this invention, by changing a reflective coloring ratio and a transparency coloring ratio mutually as mentioned above, even if a coloring layer is common, it becomes possible to set up independently the coloring mode of a reflective mold display, and the coloring mode of a transparency mold display.

[0037] Next, while arranging the light filter substrate of this invention on a substrate and said substrate, having the reflecting layer which has the reflective section which reflects light, and opening, and the coloring layer arranged on said substrate and arranging said coloring layer on said opening, it is characterized by being arranged only in the part on said reflective section.

[0038] Since such adjustment is unrelated to the lap condition of a coloring layer and optical opening while according to this invention the coloring layer is arranged on opening and it becomes possible to adjust the brightness of the reflected light by being arranged only in the part on the reflective section according to the lap rate to the reflecting layer of a coloring layer, it can avoid affecting the color of the transmitted light. Therefore, it becomes possible to set up independently the effect of the coloring layer to the reflected light, and the effect of a coloring layer to the transmitted light mutually.

[0039] As for the ratio of the area of said reflective section by which said coloring layer to the whole surface product of said reflective section is arranged here, it is desirable that it is smaller than the ratio of the area of said opening by which said coloring layer to the whole surface product of said opening is arranged. Although the lightness of the reflected light will become lower than the transmitted light and the saturation of the transmitted light will become lower than the saturation of the reflected light if it is usual since the transmitted light which passes optical opening to the reflected light penetrating a coloring layer twice penetrates a coloring layer only once by making a reflective coloring ratio smaller than a transparency coloring ratio, the brightness of the reflected light can be raised for every pixel -- both the saturation of the transmitted light can be raised relatively and a difference of the color between the reflected light and the transmitted light can be reduced for every pixel.

[0040] Moreover, it is desirable to be arranged so that said coloring layer may cover said target opening thoroughly. By being arranged so that a coloring layer may cover optical opening thoroughly, the saturation of the transmitted light can be raised further.

[0041] Furthermore, as for said coloring layer, it is desirable to be arranged so that it may jut out of on said opening on said reflective section of said perimeter of opening. By arranging the coloring layer so that it may jut out of on opening on the reflective section of the perimeter, it becomes possible to form a coloring layer as a thing of one. Therefore, it becomes unnecessary to form the pattern of a coloring layer so finely, and, easier moreover, can manufacture by the high yield.

[0042] Moreover, the substrate with which, as for another light filter substrate of this invention, the pixel was set up, While having the reflecting layer which has the coloring layer arranged on said substrate according to said pixel, the reflective section which is arranged on a substrate according to said pixel, and reflects light, and opening and arranging said coloring layer on said opening It is characterized by being arranged at least in the part on said reflective section.

[0043] Since such adjustment is unrelated to the lap condition of a coloring layer and optical opening while according to this invention the coloring layer is arranged on opening and it becomes possible to adjust the brightness of the reflected light for every pixel by being arranged only in the part on the reflective section according to the lap rate to the reflecting layer of a coloring layer, it can avoid affecting the color of the transmitted light. Therefore, it becomes possible to set up independently the effect of the coloring layer to the reflected light, and the effect of a coloring layer to the transmitted light mutually.

[0044] As for the ratio of the area of said reflective section by which said coloring layer to the whole surface product of said reflective section has been arranged here, it is desirable that it is smaller than the ratio of the area of said opening by which said coloring layer to the whole surface product of said opening has been arranged. Although the lightness of the reflected light will become lower than the transmitted light and the saturation of the transmitted light will become lower than the saturation of the reflected light if it is usual since the transmitted light which passes optical opening to the reflected light

penetrating a coloring layer twice penetrates a coloring layer only once by making a reflective coloring ratio smaller than a transparency coloring ratio, the brightness of the reflected light can be raised for every pixel -- both the saturation of the transmitted light can be raised relatively and a difference of the color between the reflected light and the transmitted light can be reduced for every pixel.

[0045] Moreover, it is desirable to be arranged so that said coloring layer may cover said opening thoroughly. By being arranged so that a coloring layer may cover optical opening thoroughly, the saturation of the transmitted light can be raised further.

[0046] Furthermore, as for said coloring layer, it is desirable to be arranged so that it may jut out of on said opening on said reflective section of said perimeter of opening. By arranging the coloring layer so that it may jut out of on opening on the reflective section of the perimeter, it becomes possible to form a coloring layer as a thing of one. Therefore, it becomes unnecessary to form the pattern of a coloring layer so finely, and, easier moreover, can manufacture by the high yield.

[0047] Next, the substrate with which, as for another light filter substrate of this invention, the pixel was set up, Two or more kinds of coloring layers which have been arranged on said substrate according to said pixel and which have a color which is mutually different, While being arranged on said substrate according to said pixel, having the reflecting layer which has the reflective section which reflects light, and opening and arranging said coloring layer on said opening and said reflective section It is characterized by two or more said things [that said a kind of coloring / at least / layer of the coloring layers of a class is arranged only in the part on said reflective section].

[0048] As for the area of opening of said reflecting layer, in this invention, it is desirable to be identically constituted between said pixels equipped with said coloring layer of a different color. Since the amount of incident light can be made equal in the pixel of each color by being identically constituted between the pixels equipped with the coloring layer of the color from which the area of opening of a reflecting layer differs, it becomes possible to perform color adjustment of a transparency display comparatively simply. Moreover, since it is identically constituted between the pixels equipped with the coloring layer of a color which is different also about the area of the reflective section, in case color adjustment of a reflective display is performed, it becomes easy to adjust the area on the reflective section of the coloring layer to each color.

[0049] Moreover, as for the rate of coat area on said reflective section of said coloring layer, it is desirable to differ between said pixels equipped with said coloring layer of at least two different colors. While adjusting the optical property of the coloring layer of each color so that this may optimize the color of the transparency display realized by the transmitted light of opening, it becomes possible to optimize the color of a reflective display by adjusting the rate of coat area of the coloring layer of each color which laps with the reflective section. Therefore, the color of a transparency display and the color of a reflective display can be independently adjusted about each color, respectively.

[0050] In this case, it has red, green, and said coloring layer of each blue color, and, as for said rate of coat area of said green coloring layer, it is desirable that it is smaller than said rate of coat area of red and said blue coloring layer. Although a transparency display is constituted by the light which penetrated the coloring layer only once in the field which laps with opening, a reflective display is mainly constituted by the light which penetrates a coloring layer twice in the field which laps with the reflective section, and is influenced by the reflected light by the coloring layer in the field which laps with opening selectively. Therefore, generally, a reflective display tends to become dark, while saturation becomes high rather than a transparency display. By the way, even if relative luminous efficiency raises the saturation of a green light to an yellow-green wavelength field to becoming dark if the saturation of the light of red and blue goes up since it has a peak, it cannot become dark easily. Thereby, if it is going to raise lightness in a reflective display, it will become easy for especially the saturation of red or blue to fall. therefore, the pixel of red or blue -- setting -- the rate of coat area -- high -- carrying out (or [namely, / losing the area of the reflective section which does not lap with a coloring layer] -- or) It becomes possible to increase lightness substantially, securing [lessen, secure saturation, and] the color repeatability of a reflective display, if the amount of reflected lights is earned by what the rate of coat area is made low for in a green pixel (that is, the area of the reflective section which does not

lap with a coloring layer is increased).

[0051] Furthermore, said rate of coat area of said green coloring layer is 30 - 50%, and, as for said rate of coat area of red and said blue coloring layer, it is desirable that it is 60 - 100%. The color repeatability and lightness of a reflective display can be raised securing the color repeatability of a transparency display by setting the green rate of coat area, red, and the blue rate of coat area as the above-mentioned range. As a rate of coat area of an especially green coloring layer, it is most desirable that it is 85 - 100% of range as a rate of coat area of red and a blue coloring layer 35 to 45%.

[0052] Moreover, as for said reflective section, being arranged in the perimeter enclosure of said opening is desirable. Since it will be formed in the condition that opening was enclosed by the reflective section in the reflecting layer, by this, even if a location gap of some occurs between a coloring layer and a reflecting layer, the field which is not covered in a coloring layer can be prevented from being generated in opening. As for said especially opening, it is desirable to be formed in the center of abbreviation of said reflecting layer.

[0053] Furthermore, as for the numerical aperture to said reflecting layer by said opening, it is desirable that it is 30 - 70%. Since a reflective display will generally become conversely dark although a transparency display becomes bright if the numerical aperture of a reflecting layer becomes large, it is necessary to set up the numerical aperture of a reflecting layer so that the balance of a transparency display and a reflective display may be taken. If a numerical aperture is too small, it is necessary to make the illuminance of a back light high, and, more specifically, the power consumption of a back light will increase. Moreover, if a numerical aperture is too large, a reflective display will become dark and it will be hard coming to check by looking. Since the brightness of a reflective display can be earned by establishing the field which does not lap with a coloring layer in a part of reflective section with this operation gestalt It compares, when adopting the structure which put the coloring layer on the whole reflecting layer, or when it constitutes the coloring layer of an optical property which is different in the part which laps with the reflective section, and the part which laps with opening. In the above-mentioned range where a numerical aperture is large, it becomes possible to balance a transparency display and a reflective display, and good color grace can be realized in the both sides of a transparency display and a reflective display. If a numerical aperture is less than the above-mentioned range, since power consumption will increase from the need of securing the lightness of a transparency display, it is hard coming to adopt it as pocket mold electronic equipment, such as a cellular phone. Moreover, if a numerical aperture exceeds the above-mentioned range, coexistence of the lightness in a reflective display and saturation will become difficult, and it will become difficult to secure the color grace in a reflective display.

[0054]

[Embodiment of the Invention] Next, the operation gestalt of the electro-optic device built over this invention with reference to an accompanying drawing, a light filter substrate, and electronic equipment is explained to a detail.

[0055] [1st operation gestalt] drawing 1 is the outline perspective view showing the appearance of the liquid crystal panel 200 which constitutes the electro-optic device of the 1st operation gestalt concerning this invention, and it is the amplification part plan of the light filter substrate 210 with which drawing 2 (a) constitutes the typical outline sectional view of a liquid crystal panel 200, and drawing 2 (b) constitutes a liquid crystal panel 200.

[0056] This electro-optic device comes suitably to attach lighting systems, case objects, etc. which are not illustrated if needed, such as a back light and a front light, to the liquid crystal panel 200 which has the so-called passive matrix mold structure of a reflective transfective method.

[0057] As shown in drawing 1, the liquid crystal panel 200 is equipped with the cellular structure which it comes to close with a sealing agent 231, after the light filter substrate 210 which uses as a base the 1st transparent substrate 211 which consists of a glass plate, a synthetic-resin plate, etc., and the opposite substrate 220 which uses as a base the 2nd same substrate 221 which counters this are stuck through a sealant 230 and liquid crystal 232 is poured in from inlet 230a inside a sealant 230.

[0058] On the inner surface (front face which counters the 2nd substrate 221) of the 1st substrate 211,

the transparent electrode 216 of the shape of a stripe arranged in parallel is formed, and the transparent electrode 222 of the shape of a stripe arranged in parallel is formed on the inner surface of the 2nd substrate 221. [two or more] [two or more] Moreover, the above-mentioned transparent electrode 216 is connected conductively to wiring 218A, and the above-mentioned transparent electrode 222 is connected conductively to wiring 228. It intersects perpendicularly mutually, and the crossover field constitutes the pixel of a large number arranged in the shape of a matrix, and, as for a transparent electrode 216 and a transparent electrode 222, these pixel arrays constitute the liquid crystal display field A.

[0059] The 1st substrate 211 has substrate overhang section 210T which it comes to ***** outside the appearance of the 2nd substrate 221, and above-mentioned wiring 218A, wiring 218B connected conductively through the vertical flow section which consists of a part of sealants 230 to the above-mentioned wiring 228, and the input terminal section 219 which consists of two or more circuit patterns formed independently are formed on these substrate overhang section 210T. Moreover, on substrate overhang section 210T, the semiconductor IC 261 which built in the liquid crystal actuation circuit etc. is mounted so that it may be connected conductively to these wiring 218A and 218B and the input terminal section 219. Moreover, the flexible wiring substrate 263 is mounted in the edge of substrate overhang section 210T so that it may be connected conductively to the above-mentioned input terminal section 219.

[0060] In this liquid crystal panel 200, as shown in drawing 2, in the outside surface of the 1st substrate 211, the phase contrast plate (quarter-wave length plate) 240 and a polarizing plate 241 are arranged, and the phase contrast plate (quarter-wave length plate) 250 and the polarizing plate 251 are arranged in the outside surface of the 2nd substrate 221.

[0061] The structure of the light filter substrate 210 is explained to a detail with reference to <the structure of the light filter substrate 210> next drawing 2 (a), and (b). A reflecting layer 212 is formed in the front face of the 1st substrate 211, and opening 212a is prepared for every above-mentioned pixel. It is reflective section 212b in which parts other than opening 212a reflect light substantially among this reflecting layer 212. In the case of this operation gestalt, the reflecting layer 212 which has opening 212a and reflective section 212b for every pixel is formed. But a reflecting layer 212 may be formed in the whole liquid crystal display field A, and only opening 212a may be formed for every pixel.

[0062] The coloring layer 214 was formed on the reflecting layer 212, and the surface protective layer (overcoat layer) 215 which consists of transparence resin etc. has covered a it top. A light filter is formed of this coloring layer 214 and the surface protective layer 215.

[0063] Into transparence resin, the coloring layer 214 shall distribute coloring matters, such as a pigment and a color, and shall usually present the predetermined color tone. Although there are some which consist of combination of three colors of R (red), G (green), and B (blue) as a primary color system filter as an example of the color tone of a coloring layer, it is not limited to this and can form in the various color tones of a complementary color system and others. Usually, the coloring layer which has a predetermined color pattern is formed by applying the coloring resist which consists of a photopolymer containing coloring matters, such as a pigment and a color, on a substrate front face, and removing a garbage by the photolithography method. Here, in forming the coloring layer of two or more color tones, it repeats the above-mentioned process.

[0064] In addition, although the stripe array is adopted as an array pattern of a coloring layer in the example of a graphic display shown in drawing 2 (b), various pattern configurations other than this stripe array, such as a delta array and a slanting mosaic array, are employable. Moreover, the light-shielding film (a black matrix or black mask) for shading the field between pixels can be formed in the perimeter of each coloring layer of Above RGB as a part of coloring layer.

[0065] On the surface protective layer 215, the transparent electrode 216 which consists of transparence conductors, such as ITO (indium stannic-acid ghost), is formed. A transparent electrode 216 is formed in band-like [which is extended to the graphic display up down one of drawing 2 (b)], and two or more transparent electrodes 216 arrange it in parallel mutually, and it is constituted in the shape of a stripe. On the transparent electrode 216, the orientation film 217 which consists of polyimide resin etc. is formed.

[0066] In this operation gestalt, while the coloring layer 214 which constitutes a light filter has lapped superficially so that opening 212a of a reflecting layer 212 may be thoroughly covered in each pixel as shown in drawing 2 (b), it is formed in one so that it may jut out of the field which laps with opening 212a superficially on reflective section 212b around opening 212a towards a perimeter.

[0067] Moreover, the coloring layer 214 is not formed in each whole pixel, and it is formed so that it may lap with a part of reflecting layer 212. That is, the field (inner circumference field which attends opening 212a in the example of a graphic display) which laps with the coloring layer 214 superficially, and the field (the example of a graphic display periphery field) which does not lap with the coloring layer 214 superficially exist in a reflecting layer 212.

[0068] On the other hand, in the above-mentioned liquid crystal panel 200, the above-mentioned light filter substrate 210 and the opposite substrate 220 which counters carry out the laminating of the hard protective coat 223 which consists of the same transparent electrode 222 as the above, SiO₂, TiO₂, etc. on the 2nd substrate 221 which consists of glass etc., and the same orientation film 224 as the above one by one.

[0069] In this operation gestalt constituted as mentioned above, it reflects in reflective section 212b, without reflecting in reflective section 212b and a part passing the coloring layer 214, after a part penetrates the coloring layer 214, and the outdoor daylight which carried out incidence to reflective section 212b from the opposite substrate 220 side penetrates and carries out outgoing radiation of the opposite substrate 220 again. Although the outdoor daylight which penetrates the coloring layer 214 passes the coloring layer 214 twice at this time, outgoing radiation of the outdoor daylight which does not penetrate the coloring layer 214 is carried out without passing the coloring layer 214. Therefore, the lightness of a reflective mold display can be raised compared with the case where the coloring layer 214 has covered the reflecting layer 212 whole in a pixel.

[0070] On the other hand, since the coloring layer 214 has covered all opening 212a of a reflecting layer 212, when the back light etc. is arranged, for example behind the light filter substrate 210 and the illumination light is irradiated from behind, a part of illumination light concerned passes opening 212a, it penetrates the coloring layer 214, and passes and carries out outgoing radiation of liquid crystal 232 and the opposite substrate 220. Therefore, in order that the transmitted light may penetrate the coloring layer 214 only once, the color of the transparency mold display according to the depth of shade (degree which gives a bias to the spectrum distribution of a light field when light is made to penetrate) of the coloring layer 214 is acquired. Since the reflected light component which does not pass a coloring layer as mentioned above is contained and the saturation of the reflected light falls at this time, the saturation of a transparency mold display increases relatively.

[0071] With this operation gestalt, the color of a reflective mold display, especially lightness are securable by forming the optical property of the coloring layer 214 so that it may correspond to a transparency mold display, and adjusting the reflector product of reflective section 212b which laps with the coloring layer 214 superficially. Therefore, the saturation of a transparency mold display can be raised, securing the brightness of a reflective mold display. Moreover, the difference in the color (it is especially saturation and lightness) a reflective mold display and a transparency mold display can also be reduced.

[0072] the above-mentioned effectiveness -- the production process of the usual light filter -- the same -- a coloring layer -- overall -- about -- while forming at Mr. one's depth of shade (for example, the concentration of coloring matters, such as a pigment and a color, -- about -- Mr. 1) -- a coloring layer -- overall -- about -- it is suitable especially when forming in Mr. one's thickness. In this case, conventionally, since the optical property of the field which laps with opening 212a in the coloring layer 214 superficially, and the field which laps with reflective section 212b in the coloring layer 214 superficially is mostly in agreement, since a difference of big saturation and lightness arises inevitably between the color of a reflective mold display, and the color of a transparency mold display, with structure, the effectiveness of this invention will become remarkable especially.

[0073] Although what is necessary is to show the coloring mode of color suitable for each in a reflective mold display and a transparency mold display, and just to be able to prepare the separate light filter in

each, it is desirable actually on manufacture to realize both displays with a common light filter. With this operation gestalt, by changing a reflective coloring ratio and a transparency coloring ratio mutually as mentioned above, even if the coloring layer was common, it became possible to set up independently the coloring mode of a reflective mold display, and the coloring mode of a transparency mold display. [0074] The 2nd operation gestalt which starts this invention with reference to the [2nd operation gestalt] next drawing 3 (a), and (b) is explained. In the liquid crystal panel 300 of this operation gestalt, since it has the 1st same substrate 311 as the above-mentioned 1st operation gestalt, the 2nd substrate 321, the coloring layer 314, the surface protective layer 315, a transparent electrode 316, the orientation film 317, a transparent electrode 322, the hard protective coat 323, the orientation film 324, a sealant 330, liquid crystal 332, the phase contrast plate 340,350, and the polarizing plate 341,351, explanation is omitted about these.

[0075] In the liquid crystal panel 300 of this operation gestalt, the reflecting layer 312 is formed in one almost extensively in the liquid crystal display field, and opening 312a is prepared for every pixel. It is reflective section 312b in which parts other than opening 312a reflect light substantially among this reflecting layer 312. Moreover, black light-shielding film 314BM which consists of black resin etc. is formed in the field between pixels. The thing which distributed coloring matters, such as a black pigment and a color, in transparency resin as black resin, or the thing which was made to mix both the coloring matters of three colors of R (red), G (green), and B (blue), and was distributed in transparency resin is used.

[0076] Although the reflecting layer 312 should be continued for two or more pixels and it should be formed in one with this operation gestalt, a reflecting layer may be formed for every pixel like the 1st operation gestalt, and the above-mentioned black light-shielding film may be formed between reflecting layers.

[0077] The 3rd operation gestalt which starts this invention with reference to the [3rd operation gestalt] next drawing 4 (a), and (b) is explained. Since the liquid crystal panel 400 of this operation gestalt has the 1st same substrate 411 as the above-mentioned 2nd operation gestalt, the 2nd substrate 421, the reflecting layer 412 that has opening 412a and reflective section 412b, a transparent electrode 416, the orientation film 417, a transparent electrode 422, the orientation film 423, a sealant 430, liquid crystal 432, the phase contrast plate 440,450, and the polarizing plate 441,451, it omits explanation about these.

[0078] In this operation gestalt, as shown in drawing 4 (a), the light filter is formed not on the 1st substrate 421 with which the reflecting layer 412 was formed but on the 2nd substrate 421. On the 2nd substrate 421, the coloring layer 424 is formed for every pixel, and, more specifically, the same black light-shielding film 424BM as the 2nd operation gestalt is formed in the field between pixels. The transparent surface protective layer 425 is formed on the coloring layer 424 and black light-shielding film 424BM.

[0079] A transparent electrode 422 is formed on the above-mentioned surface protective layer 425, and the orientation film 423 is formed on this transparent electrode 422.

[0080] As shown in drawing 4 (b), to the reflective substrate 410 with which the reflecting layer 412 was formed, the coloring layer 424 (graphic display alternate long and short dash line) of the light filter substrate 420 laps with opening 412a of a reflecting layer 412 superficially, and it is constituted so that opening 412a may be covered thoroughly. Moreover, the coloring layer 424 is constituted by one so that it may ***** to the field which laps with reflective section 412b of a reflecting layer 412 towards a perimeter from the field which laps with opening 412a superficially. That is, the reflecting layer 412 is equipped with the field (the example of a graphic display inner circumference field) which laps with the coloring layer 424 superficially, and the field (the example of a graphic display periphery field) which does not lap with the coloring layer 424 superficially.

[0081] If the superficial lap mode of a reflecting layer 412 and the coloring layer 424 is constituted as mentioned above even if formed on the substrate with which a reflecting layer 412 differs from the coloring layer 424 like this operation gestalt, the same operation effectiveness as the 1st operation gestalt and the 2nd operation gestalt can be done so.

[0082] With reference to [the other examples of a configuration], next drawing 5 (a) - (d) and drawing 6 (a) - (d), the example of a configuration of others applicable to each above-mentioned operation gestalt is explained. Each example of a configuration explained below illustrates and explains only the superficial physical relationship of a reflecting layer and a coloring layer.

[0083] (Example 1 of a configuration) the coloring layer 514 which presents the hue of R (red) on the reflecting layer 512 equipped with opening 512a in each pixel in the example 1 of a configuration shown in drawing 5 (a) -- it is formed so that 514g of coloring layers which present the hue of r and G (green), and coloring layer 514b which presents the hue of B (blue) may lap superficially, respectively. Like each above-mentioned operation gestalt, it is constituted so that the coloring layers 514r, 514g, and 514b in each pixel may cover opening 512a thoroughly, respectively, and this example of a configuration is consisted of by one so that it may ***** to the field which laps with a surrounding reflector and a surrounding flat-surface target from the field which laps with opening 512a superficially.

[0084] (Example 2 of a configuration) the coloring layer 614 which presents the hue of R (red) on the reflecting layer 612 equipped with opening 612a in each pixel in the example 2 of a configuration shown in drawing 5 (b) -- it is formed so that 614g of coloring layers which present the hue of r and G (green), and coloring layer 614b which presents the hue of B (blue) may lap superficially, respectively. If each coloring layers 614r, 614g, and 614b cover opening 612a thoroughly, it does not break by this example of a configuration, but the field which does not lap with a coloring layer and a flat-surface target exists in a part of opening 612a.

[0085] In order to reduce the difference in the color a reflective mold display and a transparency mold display, it consists of this example 2 of a configuration so that a reflective coloring ratio (surface ratio of a field which laps with the coloring layer to total reflection area and the flat-surface target of a reflecting layer 612) may become smaller than a transparency coloring ratio (surface ratio of a field which laps with the coloring layer to full admission opening area and the flat-surface target of opening 612a). Consequently, the lightness of a reflective display improves and the saturation of a transparency mold display increases relatively.

[0086] (Example 3 of a configuration) In the example 3 of a configuration shown in drawing 5 (c) So that it may lap superficially on the reflecting layer 712 equipped with opening 712a in each pixel, respectively the coloring layers 714r, 715r, and 716 which present two or more hues of R (red), respectively -- the coloring layers 714g, 715g, and 716g which present the hue of r and G (green), and the coloring layers 714b, 715b, and 716b which present the hue of B (blue) are formed.

[0087] It consists of this example of a configuration so that the coloring layers 714r, 714g, and 714b may lap with opening 712a superficially and the other coloring layers 715r, 715g, 715b, 716r, 716g, and 716b may lap superficially only on the reflector of a reflecting layer 712. Thus, it may be constituted so that two or more coloring layers may lap superficially in each pixel, respectively.

[0088] (Example 4 of a configuration) the coloring layer 814 which presents the hue of R (red) on the reflecting layer 812 equipped with opening 812a in the example 4 of a configuration shown in drawing 5 (d) -- it is formed so that 814g of coloring layers which present the hue of r and G (green), and coloring layer 814b which presents the hue of B (blue) may lap superficially, respectively. It is the value from which it consisted of this example of a configuration so that the coloring layers 812r, 812g, and 812b might become area which is mutually different, consequently the reflective coloring ratio (ratio of the reflector product which lapped with the coloring layer to total reflection area and flat-surface target in a pixel) differed mutually according to the hues R (red), G (green), and B (blue) of a coloring layer. Speaking more generally, the ratio of the above-mentioned reflective coloring ratio and a transparency coloring ratio (ratio of opening area which lapped with the coloring layer to full admission opening area and flat-surface target in a pixel) serving as a value which is mutually different for every color.

[0089] It not only can set up independently the color of a reflective mold display and a transparency mold display like the above-mentioned operation gestalt or other examples of a configuration, but according to this example 4 of a configuration, according to the construction material of the coloring layer of each color, it can obtain suitable color by setting up the above-mentioned reflective coloring ratio (or ratio of a reflective coloring ratio and a transparency coloring ratio) for every color.

[0090] (Example 5 of a configuration) In the example 5 of a configuration shown in drawing 6 (a), opening 912a of plurality (the example of a graphic display two) is prepared for every pixel in the reflecting layer 912. It is reflective section 912b in which parts other than opening 912a reflect light substantially among this reflecting layer 912. And in two or more opening 912a, the coloring layers 914r, 914g, and 914b which lap with this reflecting layer 912 superficially are constituted, respectively so that it may lap superficially with a part of reflective section 912b with a wrap.

[0091] (Example 6 of a configuration) In the example 6 of a configuration shown in drawing 6 (b), the coloring layers 1014r, 1014g, 1014b, 1015r, 1015g, 1015b, 1016r, 1016g, and 1016b of plurality (the example of a graphic display three) which lap with the reflecting layer 1012 which has opening 1012a and reflective section 1012b superficially are formed. Here, the coloring layers 1014r, 1014g, and 1014b are constituted so that it may lap with opening 1012a superficially, and the coloring layers 1015r, 1015g, 1015b, 1016r, 1016g, and 1016b are constituted so that it may lap superficially with a part of reflective section. And the coloring layers 1014r, 1014g, and 1014b are constituted so that it may have the depth of shade higher than the coloring layers 1015r, 1015g, 1015b, 1016r, 1016g, and 1016b, namely, so that coloring matters, such as a pigment and a color, may be included more in high concentration.

[0092] The optical concentration of the coloring layers 1014r, 1014g, and 1014b which lap with opening 1012a superficially in this example 6 of a configuration is high. Since the optical concentration of the coloring layers 1015r, 1015g, 1015b, 1016r, 1016g, and 1016b constituted so that it might lap superficially with a part of reflective section 1012b is low Compared with the case of each above-mentioned operation gestalt, the saturation of the transmitted light becomes relative still higher, and the reflected light becomes still brighter.

[0093] As mentioned above, in this invention, the case where it constitutes so that the optical concentration of a coloring layer may differ selectively is not eliminated. About especially a coloring layer, it is desirable to make low optical concentration of the field which is high and laps the optical concentration of the field which laps with optical opening and the flat-surface target of a reflecting layer with the other reflecting layer and a flat-surface target.

[0094] (Example 7 of a configuration) In the example 7 of a configuration shown in drawing 6 (c), the coloring layers 1114r, 1114g, 1114b, 1115r, 1115g, and 1115b of plurality (the example of a graphic display two) which lap with the reflecting layer 1112 which has opening 1112a and reflective section 1112b superficially are formed. The coloring layers 1114r, 1114g, and 1114b and the coloring layers 1115r, 1115g, and 1115b are independently arranged so that laminating arrangement may be carried out mutually or it may lap mutually superficially. In addition, drawing 6 (d) shows the sectional view at the time of carrying out the laminating of a reflecting layer 1112, the coloring layers 1114r, 1114g, and 1114b, and the coloring layers 1115r, 1115g, and 1115b mutually, and making them form in it in this example 7 of a configuration.

[0095] The field with which the coloring layers 1114r, 1114g, and 1114b and the coloring layers 1115r, 1115g, and 1115b lap superficially in this example 7 of a configuration, Namely, it sets to the field which laps with opening 1112a superficially. The field which is in the field in which the thickness of a coloring layer is substantially thick and the coloring layers 1114r, 1114g, and 1114b are formed, and does not lap with the coloring layers 1115r, 1115g, and 1115b superficially, That is, in the field which laps with reflective section 1112b superficially, it is constituted so that the thickness of a coloring layer may become thin substantially. Therefore, the saturation of the transmitted light improves further by the thick coloring layer, and its lightness of the reflected light improves further by forming the thin coloring layer selectively.

[0096] As mentioned above, in this invention, the case where a coloring layer changes thickness selectively and is formed is not eliminated. About especially a coloring layer, in the field which laps with optical opening and the flat-surface target of a reflecting layer, it is substantially thick, and it is desirable to form thinly substantially in the field which laps with the other reflecting layer and a flat-surface target.

[0097] The depth of shade of the coloring layers 1114r, 1114g, and 1114b constituted so that the depth of shade of the coloring layers 1115r, 1115g, and 1115b which lap with opening 1112a superficially

here in order to heighten the above-mentioned effectiveness more might be jutted out of the field which is high and laps with opening 1012a superficially over the field which laps superficially with a part of reflector may be made low.

[0098] (Example 8 of a configuration) The configuration of the example 8 of a configuration is typically shown in drawing 7. In this example 8 of a configuration, although the coloring layers 1214r and 1214b are extensively formed on the reflecting layer 1212 in R pixels and B pixels, 1214g of coloring layers is formed so that it may lap with a part of reflecting layer 1212 in G pixels. 1214g of coloring layers is constituted by breadth and this so that it may lap with a part of reflective section 1212b, so that 1214g of coloring layers may jut out opening 1212a over the opening edge with a wrap extensively.

[0099] In this example 8 of a configuration, the numerical aperture (ratio of the area of opening 1212a to the whole surface product of a reflecting layer 1212) of a reflecting layer 1212 is common to RGB each pixel, and is 30 - 70%. Moreover, the rate of coat area of G pixels (ratio of the area of 1214g of coloring layers to the area of reflective section 1212b) is 40 - 80%.

[0100] the rate of coat area of the coloring layers [on R pixels and B pixels and as opposed to reflective section 1212b by constituting as mentioned above] 1214r and 1214b (the ratio of the area of the coloring layer which laps with the reflective section 1212 to the area of the reflective section 1212 --) That is, he is trying to raise lightness by securing saturation by making a reflective coloring ratio into 100%, and making low the rate of coat area of 1214g of coloring layers to reflective section 1212b in G pixels. It becomes possible to raise the brightness of a reflective display, without reducing the saturation of R and B not much substantially, if it does in this way.

[0101] (Example 9 of a configuration) The configuration of the example 9 of a configuration is typically shown in drawing 8. In this example 9 of a configuration, coloring layer 1314b covered the reflecting layer 1312 top with B pixels extensively (100% of rates of coat area), and it has opening 1314ra to which coloring layer 1314r exposes a part of reflecting layer 1312 by R pixels. Furthermore, in G pixels, while 1314g of coloring layers laps with opening 1312a of a reflecting layer 1312 thoroughly, it was constituted so that it might ***** to the perimeter, and has lapped only with the part on reflective section 1312b.

[0102] Moreover, in this example 9 of a configuration, the numerical aperture of a reflecting layer 1312 is common to RGB each pixel, and is 30 - 70%. Moreover, the rate of coat area of G pixels of the rate of coat area of R pixels is 40 - 80% 60 to 100%.

[0103] (Example 10 of a configuration) The configuration of the example 10 of a configuration is typically shown in drawing 9. In this example 10 of a configuration, coloring layer 1414b covered the reflecting layer 1412 top with B pixels extensively (100% of rates of coat area), and it has opening 1414ra to which coloring layer 1414r exposes a part of reflecting layer 1412 by R pixels. Two opening 1414ra(s) are prepared in this example. Furthermore, in G pixels, while 1414g of coloring layers laps with opening 1412a of a reflecting layer 1412 thoroughly, it was constituted so that it might ***** to the perimeter, and has lapped only with the part on reflective section 1412b.

[0104] Moreover, in this example 10 of a configuration, the numerical aperture of a reflecting layer 1412 is common to RGB each pixel, and is 30 - 70%. Moreover, the rate of coat area of G pixels of the rate of coat area of R pixels is 40 - 80% 60 to 100%.

[0105] (Example 11 of a configuration) The configuration of the example 11 of a configuration is typically shown in drawing 10. In this example 11 of a configuration, it has opening 1514ba to which coloring layer 1514b exposes a part of reflecting layer 1512 by B pixels. Two opening 1514ba(s) are prepared in this example. Moreover, coloring layer 1514r is equipped with opening 1514ra which exposes a part of reflecting layer 1512 in R pixels. Two opening 1514ra(s) are prepared in this example. Furthermore, in G pixels, while 1514g of coloring layers laps with opening 1512a of a reflecting layer 1512 thoroughly, it was constituted so that it might ***** to the perimeter, and has lapped only with the part on reflective section 1512b.

[0106] Moreover, in this example 11 of a configuration, the numerical aperture of a reflecting layer 1512 is common to RGB each pixel, and is 30 - 70%. Moreover, the rate of coat area of B pixels is [the rate of coat area of G pixels of the rate of coat area of R pixels] 40 - 80% 60 to 100% 70 to 100%.

[0107] (Example 12 of a configuration) The configuration of the example 12 of a configuration is typically shown in drawing 11 . In this example 12 of a configuration, it has opening 1614ba to which coloring layer 1614b exposes a part of reflecting layer 1612 by B pixels. Two opening 1614ba(s) are prepared in this example. Moreover, coloring layer 1614r is equipped with opening 1614ra which exposes a part of reflecting layer 1612 in R pixels. Two opening 1614ra(s) are prepared in this example. Furthermore, in G pixels, while 1614g of coloring layers laps with opening 1612a of a reflecting layer 1612 thoroughly, it was constituted so that it might ***** to the perimeter, and has lapped only with the part on reflective section 1612b.

[0108] Moreover, in this example 12 of a configuration, the numerical aperture of a reflecting layer 1612 is common to RGB each pixel, and is 30%. Moreover, the rate of coat area of B pixels is [the rate of coat area of G pixels of the rate of coat area of R pixels] 30.2% 65.3% 65.3%.

[0109] (Example 13 of a configuration) The configuration of the example 13 of a configuration is typically shown in drawing 12 . In this example 13 of a configuration, it has opening 1714ba to which coloring layer 1714b exposes a part of reflecting layer 1712 by B pixels. Two opening 1714ba(s) are prepared in this example. Moreover, coloring layer 1714r is equipped with opening 1714ra which exposes a part of reflecting layer 1712 in R pixels. Two opening 1714ra(s) are prepared in this example. Furthermore, in G pixels, while 1714g of coloring layers laps with opening 1712a of a reflecting layer 1712 thoroughly, it was constituted so that it might ***** to the perimeter, and has lapped only with the part on reflective section 1712b.

[0110] Moreover, in this example 13 of a configuration, the numerical aperture of a reflecting layer 1712 is common to RGB each pixel, and is 30%. Moreover, the rate of coat area of B pixels is [the rate of coat area of G pixels of the rate of coat area of R pixels] 40.2% 75.4% 75.4%.

[0111] (Example 14 of a configuration) The configuration of the example 14 of a configuration is typically shown in drawing 13 . In this example 14 of a configuration, it has opening 1814ba to which coloring layer 1814b exposes a part of reflecting layer 1812 by B pixels. Two opening 1814ba(s) are prepared in this example. Moreover, coloring layer 1814r is equipped with opening 1814ra which exposes a part of reflecting layer 1812 in R pixels. Two opening 1814ra(s) are prepared in this example. Furthermore, in G pixels, while 1814g of coloring layers laps with opening 1812a of a reflecting layer 1812 thoroughly, it was constituted so that it might ***** to the perimeter, and has lapped only with the part on reflective section 1812b.

[0112] Moreover, in this example 14 of a configuration, the numerical aperture of a reflecting layer 1812 is common to RGB each pixel, and is 50%. Moreover, the rate of coat area of B pixels is [the rate of coat area of G pixels of the rate of coat area of R pixels] 47.7% 75.4% 75.4%.

[0113] (Example 15 of a configuration) The configuration of the example 15 of a configuration is typically shown in drawing 14 . In this example 15 of a configuration, the reflecting layer 1912 of each pixel is formed where reflective section 1912b of a left Uichi pair is separated, and opening 1912a is formed between them. Moreover, the coloring layers 1914b and 1914r have covered the reflecting layer 1912 with B pixels and R pixels extensively. Furthermore, in G pixels, while 1914g of coloring layers laps with opening 1912a of a reflecting layer 1912 thoroughly, it was constituted so that it might ***** to the perimeter, and has lapped only with the part on reflective section 1912b. Namely, reflective section 1912b is in the condition of having exposed selectively by opening 1914ga prepared in 1914g of coloring layers.

[0114] Moreover, in this example 15 of a configuration, the numerical aperture of a reflecting layer 1912 is common to RGB each pixel, and is 70%. Moreover, the rate of coat area of G pixels of the rate of coat area of B pixels and R pixels is 50.0% 100%.

[0115] (Optical property) Next, the optical property of the above-mentioned example 8 of a configuration thru/or the example 11 of a configuration is shown in drawing 15 . Drawing 15 shows the color data of the transmitted light of the RGB pixel of each above-mentioned example of a configuration, and the reflected light on xy chromaticity diagram in the xyz color coordinate system of 1931CIE. Generally, as xy chromaticity diagram is shown in drawing 16 , the tint actually checked by looking within the limits of the hanging bell configuration which makes a borderline the tint (a hue and

saturation) of the single wavelength light of a light field is arranged. Moreover, when performing color display using the coloring layer of three colors (for example, RGB), it is possible to form the tint in 3 square shapes formed by connecting the data point of each coloring layer RGB. The grace of color display will improve, so that the area of the three above-mentioned square shape is fundamentally large. [0116] In drawing 15, the color data (data point surrounded with the graphic display alternate long and short dash line) of a transparency display of the above-mentioned example 8-11 of a configuration and the color data (data point surrounded with the graphic display two-dot chain line) of a reflective display are written together. Here, as for a rhombus, x mark shows the data point whose triangle of a square is [data point / of example of configuration 8] the example 11 of a configuration about the data point of the example 10 of a configuration in the data point of the example 9 of a configuration. Moreover, graphic display H shows the data point of a white display.

[0117] The transparency section coloring layer which makes the numerical aperture of a reflecting layer 30%, and laps with opening to RGB each color in drawing 15, respectively in order to compare with the color data of the above-mentioned example of a configuration, It measures also about the case where the light filter substrate which formed independently the reflective section coloring layer which laps with the reflective section, and was formed in the six-step process which performs six patterning is used, and the graphic display sunspot has shown as an example of a comparison. Here, the spectral transmittance of the above-mentioned transparency section coloring layer is shown in drawing 17 (a), and the spectral transmittance of the above-mentioned reflective section coloring layer is shown in drawing 17 (b). In order that light may go in a reflective field (reflective section), in order to penetrate a reflective section coloring layer twice to light penetrating a transparency section coloring layer once in a transparency field (opening), The transparency section coloring layer adopted what shows an optical property with comparatively high saturation (an average transmission coefficient T is low), as shown in drawing 17 (a), and although a reflective section coloring layer has comparatively low saturation as shown in drawing 17 (b), the average transmission coefficient T has adopted what shows a high optical property. Thereby, the brightness of a reflective display can be improved, securing the saturation of a transparency display.

[0118] In the examples 8-11 of a configuration concerning this invention, the coloring layer which presents the spectral transmittance shown in the same optical property as the transparency section coloring layer of the example of a comparison of the above-mentioned six-step process, i.e., drawing 17 (a) was used. Consequently, as shown in drawing 15, the color grace of the reflective display near the above-mentioned example of a comparison was able to be acquired. Especially the example 11 of a configuration has the composition of having a hue and saturation substantial almost equal to the above-mentioned example of a comparison. Thus, in this invention, color grace equivalent to the case where the optical property of the filter parts of a transparency field and a reflective field is set up independently is realizable. And since every two patterning (for example, photolithography process) is not needed about RGB each color to the above-mentioned example of a comparison, respectively, it has the advantage that a manufacturing cost can be reduced substantially.

[0119] As shown in the above-mentioned examples 8-15 of a configuration, as for the area of opening of said reflecting layer, it is desirable to be identically constituted between said pixels equipped with said coloring layer of a different color. This is because the amount of incident light can be made equal in the pixel of each color by being identically constituted between the pixels equipped with the coloring layer of the color from which the area of opening of a reflecting layer differs, so it becomes possible to perform color adjustment of a transparency display comparatively simply. For example, since the opening area which constitutes a transparency field is the same to mutual in RGB each color, since the manifestation mode of a color is the same as that of a transparency mold display, about the coloring layer of RGB each color, it can be suitably adjusted on the basis of the color material of the light filter used for a transparency mold display, and can set up the optical property of color material. Moreover, since it is identically constituted between the pixels equipped with the coloring layer of a color which is different also about the area of the reflective section, in case color adjustment of a reflective display is performed, it becomes easy to adjust the area on the reflective section of the coloring layer to each color.

For example, since the reflective aspect product which constitutes a reflective field is the same to mutual in RGB each color, since the manifestation mode of a color is the same as that of a reflective mold display, about the coloring layer of RGB each color, it can be suitably adjusted on the basis of the light filter used for a reflective mold display, and can set up the rate of coat area.

[0120] In the above-mentioned example of a configuration, the rates of coat area on said reflective section of said coloring layer differ between said pixels equipped with said coloring layer of at least two different colors. While adjusting the optical property of the coloring layer of each color so that this may optimize the color of the transparency display realized by the transmitted light of opening, it becomes possible to optimize the color of a reflective display by adjusting the rate of coat area of the coloring layer of each color which laps with the reflective section. Therefore, the color of a transparency display and the color of a reflective display can be independently adjusted about each color, respectively.

[0121] When it has red, green, and the coloring layer of each blue color, brightness can be improved by making the rate of coat area of a green coloring layer smaller than the rate of coat area of red and a blue coloring layer, controlling lowering of the saturation in a reflective display. Although a transparency display is constituted by the light which penetrated the coloring layer only once in the field which laps with opening. Since it is selectively influenced also in the reflected light reflected in the part of the coloring layer in the field which is mainly constituted by the light which penetrates a coloring layer twice in the field to which a reflective display laps with the reflective section, and laps with opening, while saturation generally becomes high rather than a transparency display in a reflective display, it is easy to become dark. Therefore, in a reflective display, as an optical property of a coloring layer, even if it reduces some saturation, it is necessary to raise lightness.

[0122] However, from especially relative luminous efficiency having a peak on the wavelength of 555nm, since red and a blue twist will also look brightly as for green or yellow even if it is the same amount of light energies, the relation between saturation and lightness differs for every color. For example, in order to make bright the coloring layer of red (R pixels) or blue (B pixels), unless the light energy of the wavelength region of red or blue is increased substantially, since there are neither an increase of light (light of green with high relative luminous efficiency or yellow), nor the sushi or approaches other than red or blue, when the whole quantity of light is restricted, they will cause lowering of the large saturation which does not deserve improvement in lightness. On the other hand, since it is hard to become dark even if it raises saturation, in [which makes a subject the wavelength region where relative luminous efficiency is high] being green (G pixels), even if it raises lightness, saturation does not fall substantially.

[0123] In the case of this invention, drawing requires coexistence of the saturation in a reflective display, and lightness by adjusting the rate of coat area on the reflective section of a coloring layer. In this case, in R pixels or B pixels, if the rate of coat area is reduced greatly, although it will become bright, since saturation falls rapidly, as for the rate of coat area, it is desirable to set up highly with 60 - 100%. Although the red except green and the light of a blue wavelength region will be contained in the reflected light by reducing the rate of coat area in G pixels on the other hand, since a big difference is in relative luminous efficiency to other wavelength regions of these, since saturation does not fall, it is so desirable [saturation] to set up low with 35 - 50% as a rate of coat area. The color repeatability and lightness of a reflective display can be raised securing the color repeatability of a transparency display by setting the green rate of coat area, red, and the blue rate of coat area as the above-mentioned range.

[0124] It has set for the above-mentioned example of a configuration, and the reflective section is arranged also for the gap in the perimeter enclosure of opening. That is, it is formed in the condition that opening was enclosed by the reflective section in the reflecting layer. Therefore, even if a location gap of some occurs between a coloring layer and a reflecting layer, the field which is not covered in a coloring layer can be prevented from being generated in opening. Since a coloring layer can be formed so that it may lap with a part for a center section and its perimeter of a reflecting layer by forming opening in the center of abbreviation of a reflecting layer especially, the production by which the optical-character ability of a light filter stopped being influenced easily, and was stabilized to the patterning error etc. is attained.

[0125] As for the numerical aperture to the reflecting layer by opening, it is desirable that it is 30 - 70%. Since a reflective display will generally become conversely dark although a transparency display becomes bright if the numerical aperture of a reflecting layer becomes large, it is necessary to set up the numerical aperture of a reflecting layer so that the balance of a transparency display and a reflective display may be taken. If a numerical aperture is too small, it is necessary to make the illuminance of a back light high, and, more specifically, the power consumption of a back light will increase. Moreover, if a numerical aperture is too large, a reflective display will become dark and it will be hard coming to check by looking. since the brightness of a reflective display can work by be establish the field which do not lap with a coloring layer in a part of reflective section with this operation gestalt , it become possible and take the balance of a transparency display and a reflective display in the above-mentioned range a numerical aperture be large in the range to the whole reflecting layer compared with the case adopt the structure piled up in the coloring layer can realize good color grace in the both sides of a transparency display and a reflective display . If a numerical aperture is less than the above-mentioned range, since power consumption will increase from the need of securing the lightness of a transparency display, it is hard coming to adopt it as pocket mold electronic equipment, such as a cellular phone. Moreover, if a numerical aperture exceeds the above-mentioned range, coexistence of the lightness in a reflective display and saturation will become difficult, and it will become difficult to secure the color grace in a reflective display.

[0126] The operation gestalt in the case of using the electro-optic device containing the [operation gestalt of electronic equipment] above-mentioned liquid crystal panel as a display of electronic equipment is explained. Drawing 18 is the outline block diagram showing this whole operation gestalt configuration. The electronic equipment shown here has the same liquid crystal panel 200 as the above, and the control means 1200 which controls this. Here, a liquid crystal panel 200 is notionally divided into panel structure 200A and actuation circuit 200B which consists of semiconductor ICs etc., and it has drawn. Moreover, a control means 1200 has the source 1210 of a display information output, the display process circuit 1220, a power circuit 1230, and a timing generator 1240.

[0127] The source 1210 of a display information output is equipped with the memory which consists of a ROM (Read Only Memory), RAM (Random Access Memory), etc., the storage unit which consists of a magnetic-recording disk, an optical recording disk, etc., and the tuning circuit which carries out the alignment output of the digital picture signal, and based on various kinds of clock signals generated by the timing generator 1240, it is constituted so that display information may be supplied to the display information processing circuit 1220 in forms, such as a picture signal of a predetermined format.

[0128] The display information processing circuit 1220 performs processing of display information in which had various well-known circuits, such as a serial-parallel conversion circuit, magnification and an inverting circuit, a rotation circuit, a gamma correction circuit, and a clamping circuit, and it inputted, and supplies the image information to actuation circuit 200B with a clock signal CLK. Actuation circuit 200B includes a scanning-line actuation circuit, a data-line actuation circuit, and an inspection circuit. Moreover, a power circuit 1230 supplies a predetermined electrical potential difference to each above-mentioned component, respectively.

[0129] Drawing 19 shows the cellular phone which is 1 operation gestalt of the electronic equipment concerning this invention. The circuit board 2001 is arranged inside the case object 2010, and, as for this cellular phone 2000, the above-mentioned liquid crystal panel 200 is mounted to this circuit board 2001. A manual operation button 2020 is arranged and the antenna 2030 is attached in the front face of the case object 2010 free [frequent appearance] from the end section. A loudspeaker is arranged inside the receiver section 2040 and the microphone is built in the interior of the transmission section 2050.

[0130] The liquid crystal panel 200 installed in the case object 2010 is constituted so that the screen (the above-mentioned liquid crystal display field A) can be checked by looking through a display window 2060.

[0131] In addition, as for the electro-optic device and electronic equipment of this invention, it is needless to say that modification can be variously added within limits which are not limited only to the above-mentioned example of a graphic display, and do not deviate from the summary of this invention.

For example, although the liquid crystal panel shown in each above-mentioned operation gestalt is equipped with the structure of a passive-matrix mold, it is applicable also to the liquid crystal equipment of an active matrix using active components (active element), such as TFT (thin film transistor) and TFD (thin-film diode). Moreover, although the liquid crystal panel of the above-mentioned operation gestalt has the so-called COG type of structure, it may be constituted so that a flexible wiring substrate and a TAB substrate may be connected to the liquid crystal panel which is not the structure of mounting IC chip directly, for example, a liquid crystal panel.

[0132] Although the operation gestalt mentioned above explained the case where it applied to liquid crystal equipment, as an electro-optic device this invention is limited to this -- not having -- electroluminescence equipment -- especially Organic electroluminescence equipment, inorganic electroluminescence equipment, etc., Plasma display equipment, FED (field emission display) equipment, It is applicable to various kinds of electro-optic devices, such as equipment using the small television and digital micro mirror device (DMD) using an LED (light emitting diode) indicating equipment, an electrophoresis indicating equipment, the thin Braun tube, a liquid crystal shutter, etc.

[0133]

[Effect of the Invention] As mentioned above, as explained, according to this invention, the saturation of a transparency mold display can be improved, securing the brightness of a reflective mold display. Moreover, the difference in the color between the transparency mold displays with a reflective mold display can be reduced.

[Translation done.]

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CORRECTION OR AMENDMENT

[Kind of official gazette] Printing of amendment by the convention of 2 of Article 17 of Patent Law
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 G02F 1/1335 505
 G02B 5/20 101

[Procedure amendment]
 [Filing Date] April 13, Heisei 17 (2005. 4.13)
 [Procedure amendment 1]
 [Document to be Amended] Description
 [Item(s) to be Amended] Claim
 [Method of Amendment] Modification
 [The content of amendment]
 [Claim(s)]
 [Claim 1]

In the electro-optic device with which it has the electrooptic material layer arranged between the substrates of a couple, and comes to set up two or more pixels,
 The reflecting layer which reflects the light which has been arranged at reflective each inner section of said pixel, and passed said electrooptic material layer,
 The field in which said reflecting layer arranged in each of said pixel is not prepared,
 It is arranged and has two or more coloring layers which have two or more different colors so that it may lap with said a part of reflective section and the field in which said reflecting layer is not prepared,
 The reflective coloring ratio which is a ratio of the area of said reflective section, and the area of the field where said coloring layer in said reflective section is arranged, When the transparency coloring ratio which is a ratio of the area of the field in which said reflecting layer is not prepared, and the area of the field where said coloring layer in the field in which said reflecting layer is not prepared is arranged is set up The electro-optic device characterized by being the value from which the ratio of said reflective

coloring ratio and said transparency coloring ratio differed for every color.

[Claim 2]

In the electro-optic device with which it has the electrooptic material layer arranged between the substrates of a couple, and comes to set up two or more pixels,

The reflecting layer which reflects the light which has been arranged at reflective each inner section of said pixel, and passed said electrooptic material layer,

The field in which said reflecting layer arranged in each of said pixel is not prepared,

It has the coloring layer arranged so that it may lap with said a part of reflective section and the field in which said reflecting layer is not prepared,

The ratio of the area of said reflective section and the area of the field where said coloring layer in said reflective section is arranged is an electro-optic device characterized by being smaller than the ratio of the area of the field in which said reflecting layer is not prepared, and the area of the field where said coloring layer in the field in which said reflecting layer is not prepared is arranged.

[Claim 3]

Said coloring layer is an electro-optic device according to claim 1 or 2 characterized by being arranged so that the field in which said reflecting layer is not prepared may be covered thoroughly.

[Claim 4]

Said coloring layer is an electro-optic device according to claim 1 to 3 characterized by being arranged so that it may ***** on said reflective section of the perimeter of a field in which said reflecting layer is not prepared from on the field in which said reflecting layer is not prepared.

[Claim 5]

The area of the field in which said each of said pixel reflecting layer is not prepared is an electro-optic device according to claim 1 to 4 characterized by being substantially the same mutually.

[Claim 6]

Said reflective section is an electro-optic device according to claim 1 to 5 characterized by being arranged in the perimeter enclosure of the field in which said reflecting layer is not prepared.

[Claim 7]

Said coloring layer is equipped with two or more kinds of coloring layers which have a different color, The rate of coat area on said reflective section of said coloring layer is an electro-optic device according to claim 2 characterized by differing between said pixels equipped with said coloring layer of at least two different colors.

[Claim 8]

It is the electro-optic device according to claim 7 characterized by equipping said coloring layer with red, green, and the coloring layer of each blue color, and said rate of coat area of said green coloring layer being smaller than said rate of coat area of red and said blue coloring layer.

[Claim 9]

It is the electro-optic device according to claim 8 which said rate of coat area of said green coloring layer is 30 - 50%, and is characterized by said rate of coat area of red and said blue coloring layer being 60 - 100%.

[Claim 10]

The rate of the area of a field that said reflecting layer to the area of said reflective section is not prepared is an electro-optic device according to claim 1 to 9 characterized by being 30 - 70%.

[Claim 11]

Electronic equipment characterized by having an electro-optic device according to claim 1 to 10 and the control means which controls this electro-optic device.

[Claim 12]

The substrate with which two or more pixels were set up,

The reflecting layer which reflects the light which has been arranged at reflective each inner section of said pixel, and passed said electrooptic material layer,

The field in which said reflecting layer arranged in each of said pixel is not prepared,

It is arranged and has two or more coloring layers which have two or more different colors so that it may

lap with said a part of reflective section and the field in which said reflecting layer is not prepared, The reflective coloring ratio which is a ratio of the area of said reflective section, and the area of the field where said coloring layer in said reflective section is arranged, When the transparency coloring ratio which is a ratio of the area of the field in which said reflecting layer is not prepared, and the area of the field where said coloring layer in the field in which said reflecting layer is not prepared is arranged is set up The light filter substrate characterized by being the value from which the ratio of said reflective coloring ratio and said transparency coloring ratio differed for every color.

[Claim 13]

The substrate with which two or more pixels were set up,

The reflecting layer which reflects the light which has been arranged at reflective each inner section of said pixel, and passed said electrooptic material layer,

The field in which said reflecting layer arranged in each of said pixel is not prepared,

It has the coloring layer arranged so that it may lap with said a part of reflective section and the field in which said reflecting layer is not prepared,

The ratio of the area of said reflective section and the area of the field where said coloring layer in said reflective section is arranged is a light filter substrate characterized by being smaller than the ratio of the area of the field in which said reflecting layer is not prepared, and the area of the field where said coloring layer in the field in which said reflecting layer is not prepared is arranged.

[Procedure amendment 2]

[Document to be Amended] Description

[Item(s) to be Amended] 0014

[Method of Amendment] Modification

[The content of amendment]

[0014]

In the electro-optic device with which the electro-optic device of this invention has the electrooptic material layer arranged between the substrates of a couple, and it comes to set up two or more pixels The reflecting layer which reflects the light which has been arranged at reflective each inner section of said pixel, and passed said electrooptic material layer, The field in which said reflecting layer arranged in each of said pixel is not prepared, It is arranged so that it may lap with said a part of reflective section and the field in which said reflecting layer is not prepared. The reflective coloring ratio which is a ratio with the area of the field where said coloring layer [in / it has two or more coloring layers which have two or more different colors, and / the area of said reflective section and said reflective section] is arranged, When the transparency coloring ratio which is a ratio of the area of the field in which said reflecting layer is not prepared, and the area of the field where said coloring layer in the field in which said reflecting layer is not prepared is arranged is set up The ratio of said reflective coloring ratio and said transparency coloring ratio is characterized by being a different value for every color.

[Procedure amendment 3]

[Document to be Amended] Description

[Item(s) to be Amended] 0015

[Method of Amendment] Modification

[The content of amendment]

[0015]

Such adjustment is a coloring layer, while according to this invention the coloring layer is arranged on the field in which the reflecting layer is not prepared and it becomes possible to adjust the brightness of the reflected light by being arranged only in the part on the reflective section according to the lap rate to the reflecting layer of a coloring layer.

Since it is unrelated to a lap condition with optical opening, it can avoid affecting the color of the transmitted light. Therefore, it becomes possible to set up independently the effect of the coloring layer to the reflected light, and the effect of a coloring layer to the transmitted light mutually.

[Procedure amendment 4]

[Document to be Amended] Description

[Item(s) to be Amended] 0016

[Method of Amendment] Modification

[The content of amendment]

[0016]

Moreover, the electro-optic device of this invention has the electrooptic material layer arranged between the substrates of a couple, and sets it to the electro-optic device with which it comes to set up two or more pixels. The reflecting layer which reflects the light which has been arranged at reflective each inner section of said pixel, and passed said electrooptic material layer, The field in which said reflecting layer arranged in each of said pixel is not prepared, A ratio with the area of the field where said coloring layer [in / it has the coloring layer arranged so that it may lap with said a part of reflective section and the field in which said reflecting layer is not prepared, and / the area of said reflective section and said reflective section] is arranged (it is only hereafter called a "reflective coloring ratio".) It is characterized by being smaller than the ratio (only henceforth a "transparency coloring ratio") of the area of the field in which said reflecting layer is not prepared, and the area of the field where said coloring layer in the field in which said reflecting layer is not prepared is arranged. Although the lightness of the reflected light will become lower than the transmitted light and the saturation of the transmitted light will become lower than the saturation of the reflected light if it is usual since the transmitted light which passes optical opening to the reflected light penetrating a coloring layer twice penetrates a coloring layer only once the brightness of the reflected light can be raised by making a reflective coloring ratio smaller than a transparency coloring ratio -- both the saturation of the transmitted light can be raised relatively and a difference of the color between the reflected light and the transmitted light can be reduced.

[Procedure amendment 5]

[Document to be Amended] Description

[Item(s) to be Amended] 0017

[Method of Amendment] Modification

[The content of amendment]

[0017]

Moreover, as for said coloring layer, it is desirable to be arranged so that the field in which said reflecting layer is not prepared may be covered thoroughly. By being arranged so that a coloring layer may cover optical opening thoroughly, the saturation of the transmitted light can be raised further.

[Procedure amendment 6]

[Document to be Amended] Description

[Item(s) to be Amended] 0019

[Method of Amendment] Modification

[The content of amendment]

[0019]

Moreover, it becomes possible to form a coloring layer as a thing of one by being arranged so that said coloring layer may be jutted out on said reflective section of the perimeter of a field in which said reflecting layer is not prepared from on the field in which said reflecting layer is not prepared. Therefore, it becomes unnecessary to form the pattern of a coloring layer so finely, and, easier moreover, can manufacture by the high yield.

[Procedure amendment 7]

[Document to be Amended] Description

[Item(s) to be Amended] 0027

[Method of Amendment] Modification

[The content of amendment]

[0027]

Moreover, as for the area of the field in which said each of said pixel reflecting layer is not prepared, it is desirable that it is substantially the same mutually.

[Procedure amendment 8]

[Document to be Amended] Description

[Item(s) to be Amended] 0030

[Method of Amendment] Modification

[The content of amendment]

[0030]

In this invention, said coloring layer is equipped with two or more kinds of coloring layers which have a different color, and, as for the rate of coat area on said reflective section of said coloring layer (equivalent to the above-mentioned reflective coloring ratio), it is desirable to differ between said pixels equipped with said coloring layer of at least two different colors. While adjusting the optical property of the coloring layer of each color so that the color of the transparency display realized by the transmitted light of the field in which the reflecting layer is not prepared by this may be optimized, it becomes possible to optimize the color of a reflective display by adjusting the rate of coat area of the coloring layer of each color which laps with the reflective section. Therefore, the color of a transparency display and the color of a reflective display can be independently adjusted about each color, respectively.

[Procedure amendment 9]

[Document to be Amended] Description

[Item(s) to be Amended] 0031

[Method of Amendment] Modification

[The content of amendment]

[0031]

In this invention, said coloring layer is equipped with red, green, and the coloring layer of each blue color, and, as for said rate of coat area of said green coloring layer, it is desirable that it is smaller than said rate of coat area of red and said blue coloring layer. Although a transparency display is constituted by the light which penetrated the coloring layer only once in the field in which the reflecting layer is not prepared, and the field with which it laps, a reflective display is mainly constituted by the light which penetrates a coloring layer twice in the field which laps with the reflective section, and is influenced by the reflected light by the coloring layer in the field in which the reflecting layer is not prepared selectively, and the field with which it laps. Therefore, generally, a reflective display tends to become dark, while saturation becomes high rather than a transparency display. By the way, even if relative luminous efficiency raises the saturation of a green light to an yellow-green wavelength field to becoming dark if the saturation of the light of red and blue goes up since it has a peak, it cannot become dark easily. Thereby, if it is going to raise lightness in a reflective display, it will become easy for especially the saturation of red or blue to fall. therefore, the pixel of red or blue -- setting -- the rate of coat area -- high -- carrying out (or [namely, / losing the area of the reflective section which does not lap with a coloring layer] -- or) It becomes possible to increase lightness substantially, securing [lessen, secure saturation, and] the color repeatability of a reflective display, if the amount of reflected lights is earned by what the rate of coat area is made low for in a green pixel (that is, the area of the reflective section which does not lap with a coloring layer is increased).

[Procedure amendment 10]

[Document to be Amended] Description

[Item(s) to be Amended] 0033

[Method of Amendment] Modification

[The content of amendment]

[0033]

As for said reflective section, in this invention, it is desirable to be arranged in the perimeter enclosure of the field in which said reflecting layer is not prepared. Since the field in which the reflecting layer is not prepared will be formed in the condition of having been enclosed by the reflective section, by this, even if a location gap of some occurs between a coloring layer and a reflecting layer, the field which is not covered in a coloring layer can be prevented from being generated to the field in which the reflecting layer is not prepared. As for especially the field in which said reflecting layer is not prepared, it is desirable to be formed in the center of abbreviation of the reflective section.

[Procedure amendment 11]

[Document to be Amended] Description

[Item(s) to be Amended] 0034

[Method of Amendment] Modification

[The content of amendment]

[0034]

As for the rate of the area of a field that said reflecting layer to the area of said reflective section is not prepared, in this invention, it is desirable that it is 30 - 70%. Since a reflective display will become conversely dark although a transparency display becomes bright if the rate of the area of a field that the reflecting layer to the area of the reflective section of a reflecting layer is not prepared generally becomes large, it is necessary to set up the rate of the area of a field that the reflecting layer to the area of the reflective section of a reflecting layer is not prepared so that the balance of a transparency display and a reflective display may be taken. If the rate of the area of a field that the reflecting layer to the area of the reflective section is not prepared is more specifically too small, it is necessary to make the illuminance of a back light high, and the power consumption of a back light will increase. Moreover, if the rate of the area of a field that the reflecting layer to the area of the reflective section is not prepared is too large, a reflective display will become dark and it will be hard coming to check by looking. Since the brightness of a reflective display can be earned by establishing the field which does not lap with a coloring layer in a part of reflective section with this operation gestalt It becomes possible to balance a transparency display and a reflective display compared with the case where the structure which put the coloring layer on the whole reflecting layer is adopted, in the above-mentioned range where the rate of the area of a field that the reflecting layer to the area of the reflective section is not prepared is large. In the both sides of a transparency display and a reflective display, good color grace is realizable. If the rate of the area of a field that the reflecting layer to the area of the reflective section is not prepared is less than the above-mentioned range, since power consumption will increase from the need of securing the lightness of a transparency display, it is hard coming to adopt it as pocket mold electronic equipment, such as a cellular phone. Moreover, if the rate of the area of a field that the reflecting layer to the area of the reflective section is not prepared exceeds the above-mentioned range, coexistence of the lightness in a reflective display and saturation will become difficult, and it will become difficult to secure the color grace in a reflective display.

[Procedure amendment 12]

[Document to be Amended] Description

[Item(s) to be Amended] 0037

[Method of Amendment] Modification

[The content of amendment]

[0037]

Next, the substrate with which, as for the light filter substrate of this invention, two or more pixels were set up, The reflecting layer which reflects the light which has been arranged at reflective each inner section of said pixel, and passed said electrooptic material layer, The field in which said reflecting layer arranged in each of said pixel is not prepared, It is arranged so that it may lap with said a part of reflective section and the field in which said reflecting layer is not prepared. The reflective coloring ratio which is a ratio with the area of the field where said coloring layer [in / it has two or more coloring layers which have two or more different colors, and / the area of said reflective section and said reflective section] is arranged, When the transparency coloring ratio which is a ratio of the area of the field in which said reflecting layer is not prepared, and the area of the field where said coloring layer in the field in which said reflecting layer is not prepared is arranged is set up The ratio of said reflective coloring ratio and said transparency coloring ratio is characterized by being a different value for every color. Moreover, the substrate with which, as for the light filter substrate of this invention, two or more pixels were set up, The reflecting layer which reflects the light which has been arranged at reflective each inner section of said pixel, and passed said electrooptic material layer, The field in which said reflecting layer arranged in each of said pixel is not prepared, It has the coloring layer arranged so that it may lap with said a part of reflective section and the field in which said reflecting layer is not prepared.

The ratio of the area of said reflective section and the area of the field where said coloring layer in said reflective section is arranged is characterized by being smaller than the ratio of the area of the field in which said reflecting layer is not prepared, and the area of the field where said coloring layer in the field in which said reflecting layer is not prepared is arranged.

[Procedure amendment 13]

[Document to be Amended] Description

[Item(s) to be Amended] 0038

[Method of Amendment] Modification

[The content of amendment]

[0038]

By being arranged only in the part on the reflective section, while the coloring layer is arranged on the field in which the reflecting layer is not prepared according to this invention Since such adjustment is unrelated to the lap condition of a coloring layer and optical opening while becoming possible to adjust the brightness of the reflected light according to the lap rate to the reflecting layer of a coloring layer, it can avoid affecting the color of the transmitted light. Therefore, it becomes possible to set up independently the effect of the coloring layer to the reflected light, and the effect of a coloring layer to the transmitted light mutually.

[Procedure amendment 14]

[Document to be Amended] Description

[Item(s) to be Amended] 0113

[Method of Amendment] Modification

[The content of amendment]

[0113]

(Example 15 of a configuration) The configuration of the example 15 of a configuration is typically shown in drawing 14. In this example 15 of a configuration, the reflecting layer 1912 of each pixel is formed where reflective section 1912b of a left Uichi pair is separated, and opening 1912a is formed between them. Moreover, the coloring layers 1914b and 1914r have covered the reflecting layer 1912 with B pixels and R pixels extensively. Furthermore, in G pixels, while 1914g of coloring layers laps with opening 1912a of a reflecting layer 1912 thoroughly, it was constituted so that it might ***** to the perimeter, and has lapped only with the part on reflective section 1912b. Namely, reflective section 1912b is in the condition of having exposed selectively by opening 1914a prepared in 1914g of coloring layers.

[Translation done.]

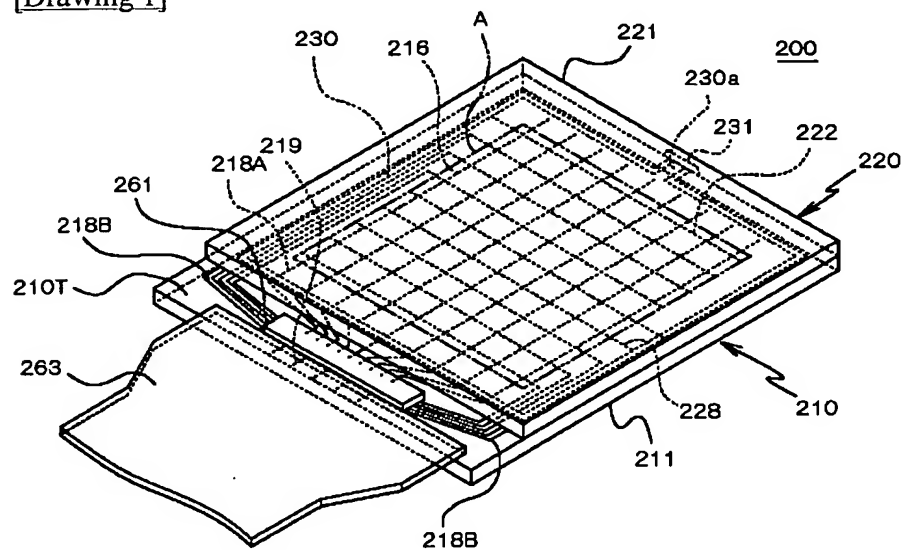
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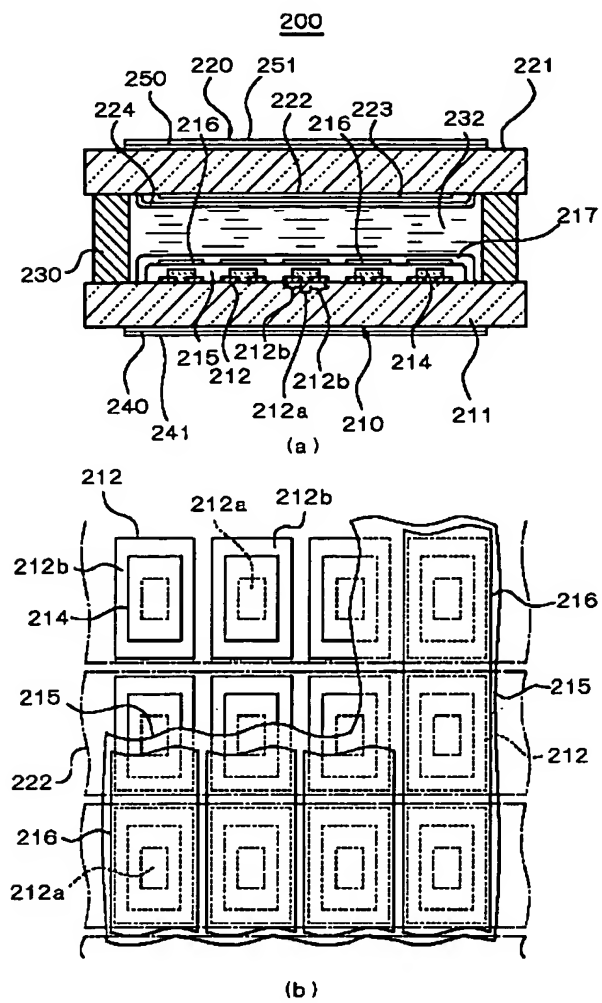
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DRAWINGS

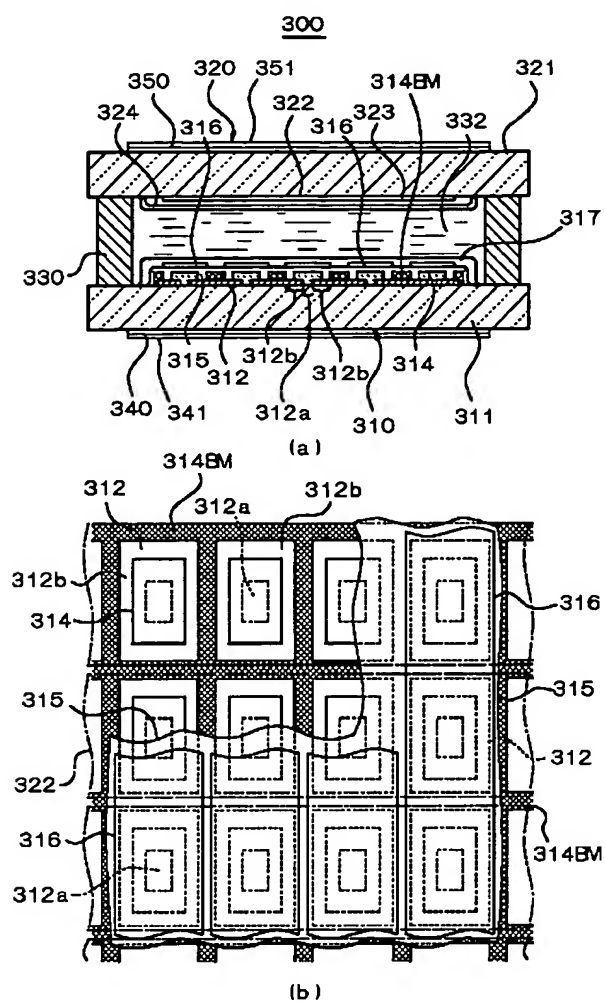
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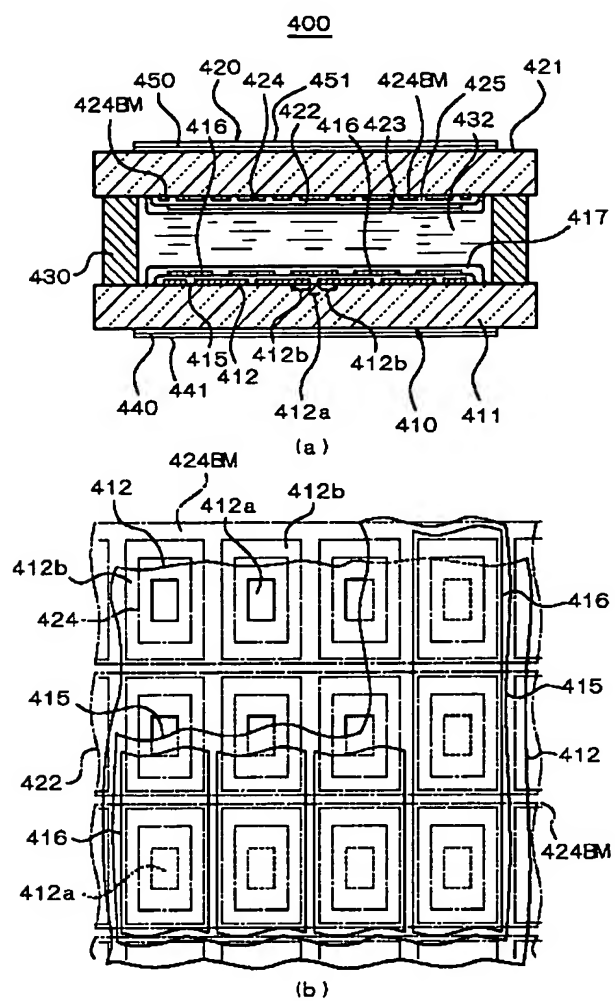
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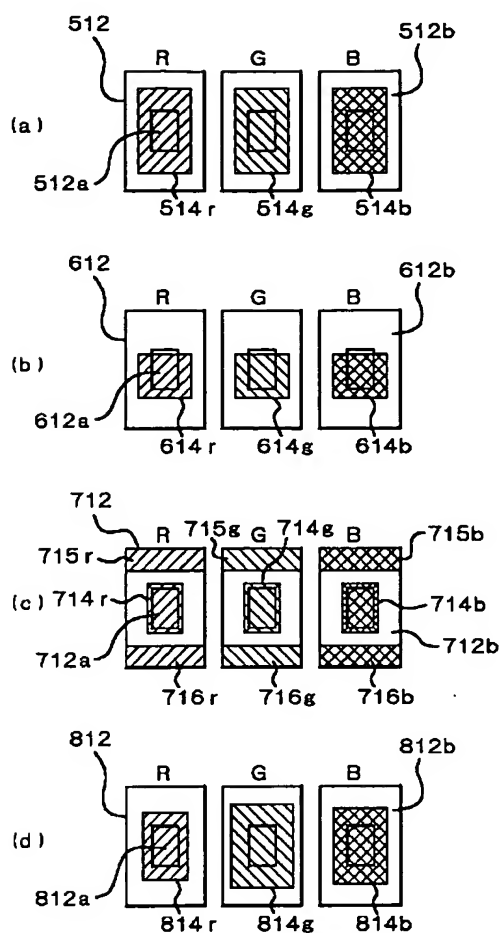
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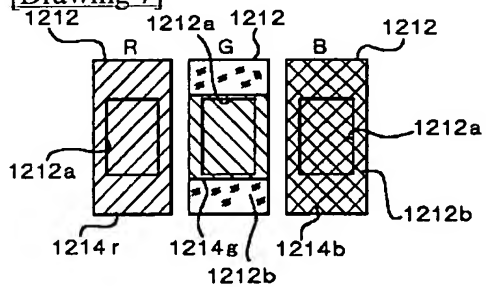
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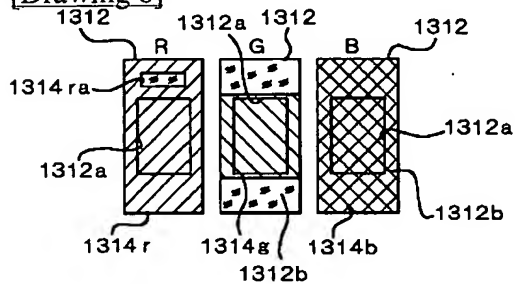
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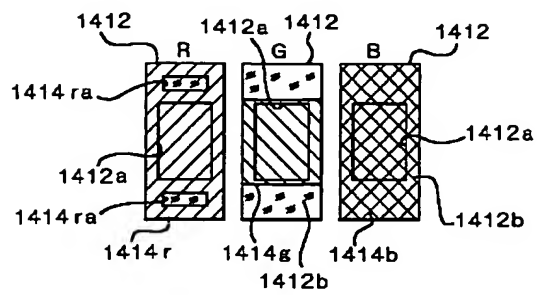
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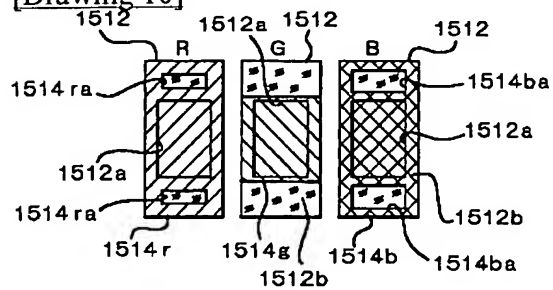
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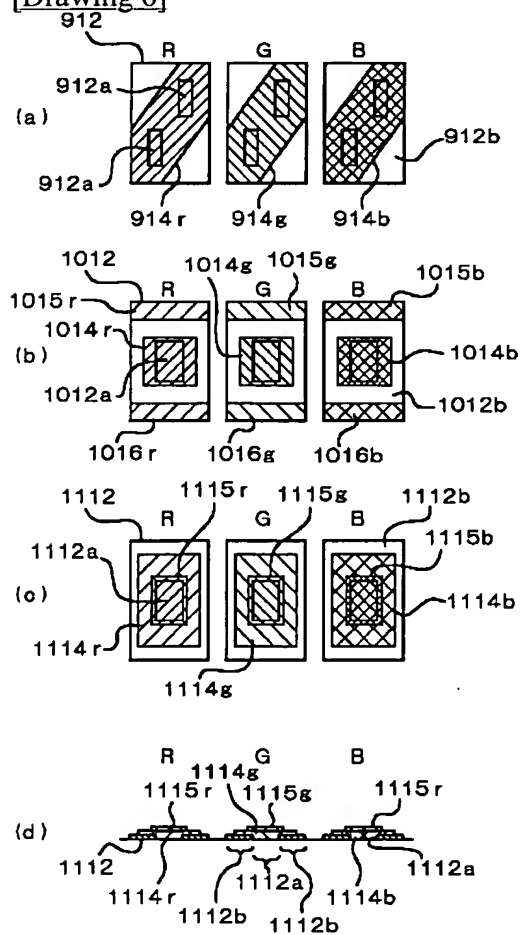
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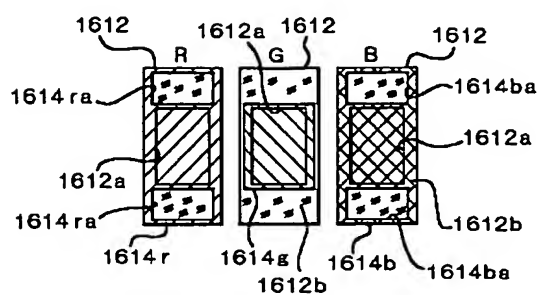
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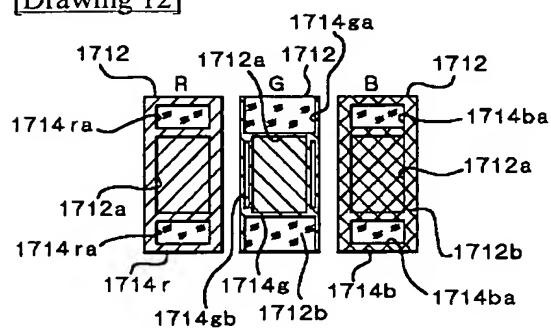
[Drawing 6]



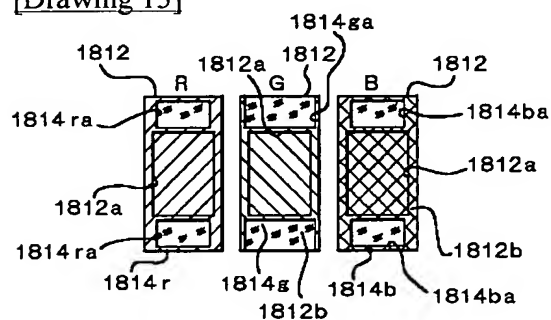
[Drawing 11]



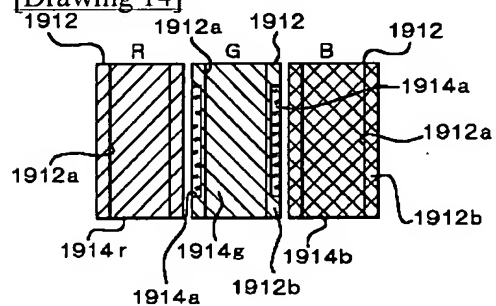
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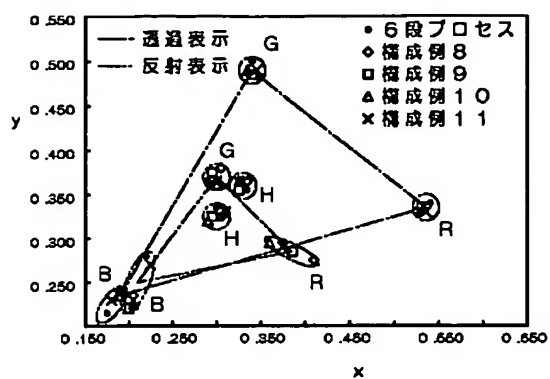
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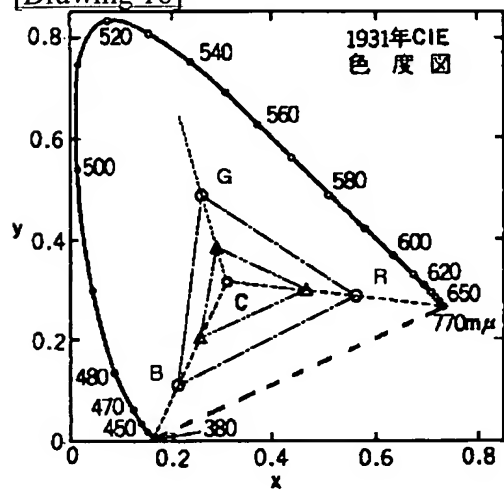
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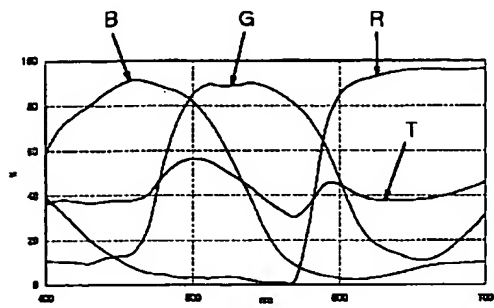
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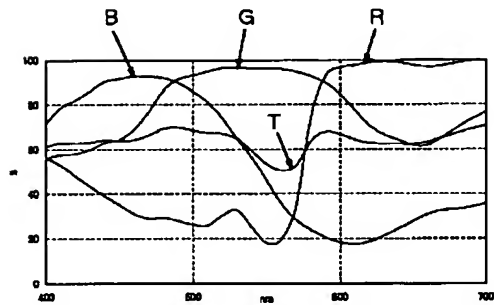
[Drawing 16]



[Drawing 17]

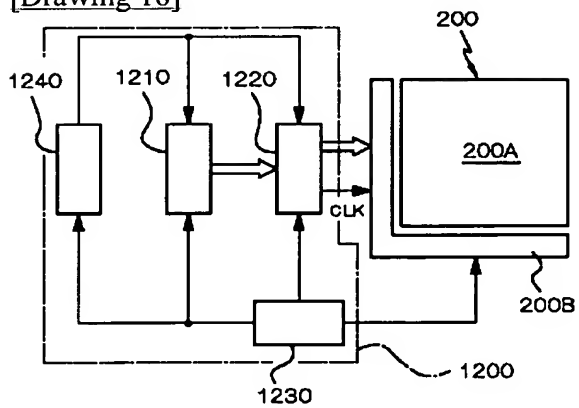


(a)

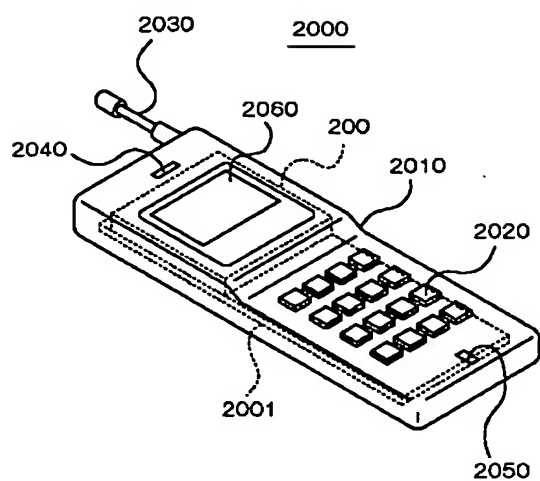


(b)

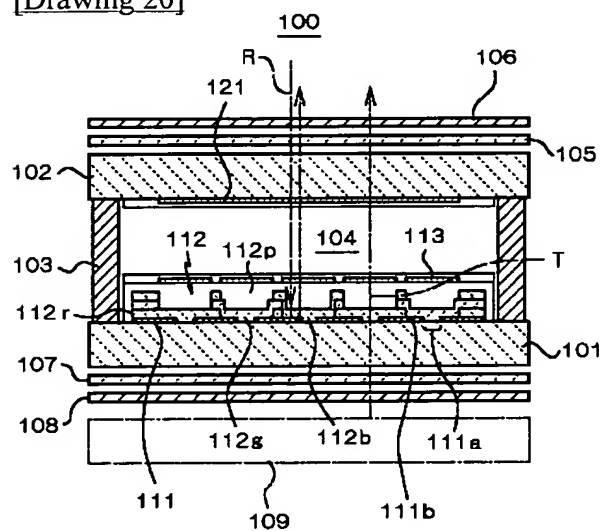
[Drawing 18]



[Drawing 19]



[Drawing 20]



[Translation done.]